ELECTRICAL TIMES

THURSDAY
2 MARCH
1950
SIXPENCE

MAZDA

the outshining light

Brilliant Success of New
MAZDA - MELLOW Fluorescent Lamp

More and more people are proving the extra value of this new MAZDA-MELLOW lighting in the home, in hotels, restaurants, clubs and showrooms, in offices and canteens—in fact, wherever a warm friendly, mellow atmosphere is desired. For MAZDA-MELLOW fluorescent lighting adds new charm to beauty, new luxury to furnishings, new delight to food and provides the perfect finishing touch to any scheme of interior decoration. At present available in 5 ft. 80 watt size and at the same price as ordinary fluorescent lamps. For further details consult any of the BTH offices throughout the country.

MAZDA LAMPS AND LIGHTING EQUIPMENT

Made in England by BTH *Leaders in Lighting*

The British Thomson-Houston Co. Ltd., Crown House, Aldwych, London, W.C.2. Tel: TEMple Bar 8040

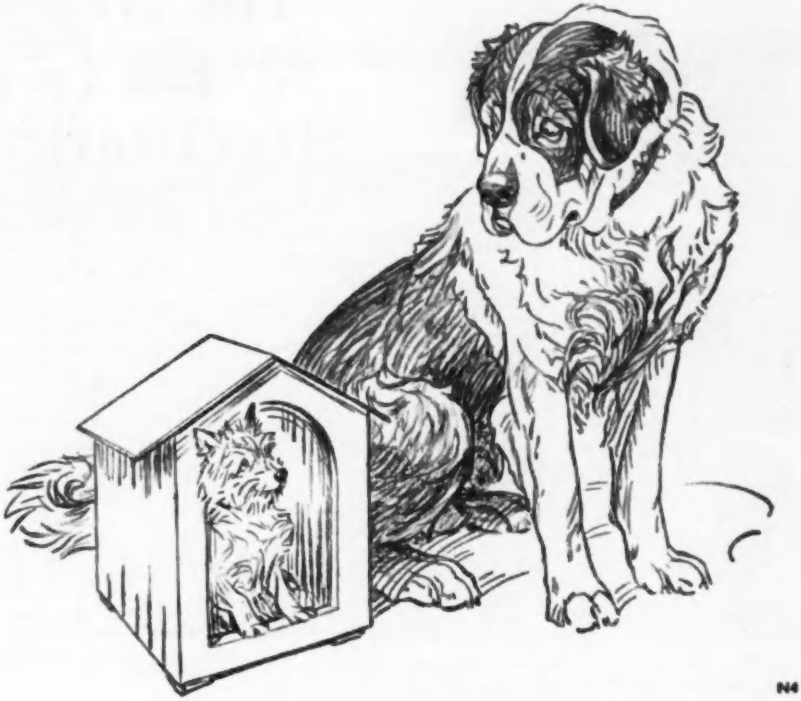
4253A

"I'm particular myself, but . . . ."

I'm particular myself, Mrs. Williams—always have been. But there's limits. Now take all the testing they do here and never being contented with things as they are and always experimenting in laborarorities and looking at every bit of Crompton cable as if it was the Crown Jewels. That's not being just particular—it's being finicky. And the cable is only to put in the ground anyway.

Crompton PAPER CABLES

CROMPTON PARKINSON LTD., CROMPTON HOUSE, ALDWYCH, LONDON, W.C.2



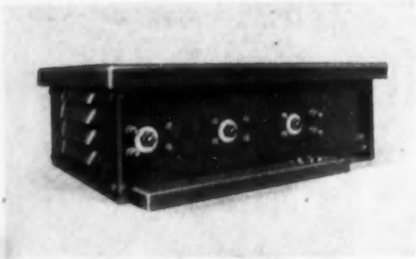
TAKES UP LESS ROOM

In a typical case, a conventional battery occupying 18 cu. ft. of space was replaced by a Nife battery of identical capacity but only needing 14 cu. ft. Moreover, as the gas produced by a Nife battery is innocuous, no separate battery room was needed. This compactness of Nife Batteries is only one of the reasons for choosing Nife for switchgear operation. In addition, Nife is made principally of steel, and so is chemically and physically almost indestructible. Nife is also unaffected by the heaviest rates of charge and discharge, and so is electrically most reliable. Many records show that it costs practically nothing to maintain a Nife battery. That's why so many are in use in the main grid power stations.

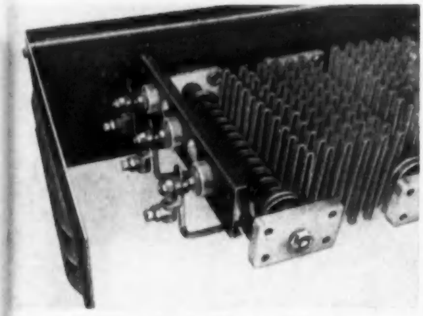
N.B. Nife batteries are not yet available for private cars or domestic radio.

CUT YOUR COSTS WITH NIFE STEEL BATTERIES

NIFE BATTERIES · REDDITCH · WORCESTERSHIRE



With cover over grid rod ends removed



Terminal bar and porcelain insulators. Side cover removed to show secondary insulations

The New

EMB

Steelworks Resistance

SPECIAL FEATURES

- Grids mounted on micanite tubes with pure mica insulation.
- Secondary insulation of highest quality.
- Sheet Steel covers over grid rod ends.
- Heavy gauge end frames with welded flange corners.
- Channel type terminal bars with porcelain insulators.
- Materials used resist foundry atmosphere.

E.M.B. Co. Ltd.

WEST BROMWICH —— ENGLAND

LIGHTING EQUIPMENT for the
CINEMA, STAGE AND BALLROOM
SEND FOR TRADE CATALOGUE

ALSO WEATHERPROOF FLOODLIGHTS

D. WALTER & CO. LTD., ACTUAL MAKERS
61-63 LANT STREET, S.E.1. *HOP 3651*

ASBESTOS WOVEN WIRE RESISTANCE NETS

COST SO LITTLE & HELP SO MUCH

Write or telephone today for full details, and technical advice if required.

CRESSALL

registered Trade Name of
The Cressall Manufacturing Co. Ltd.
Tower Street, Birmingham 19.
Telephone: ASTon Cross 2666 (3 lines).
Telegrams: "OHMIC," Birmingham.

B T-H

Hydro-electric Equipment

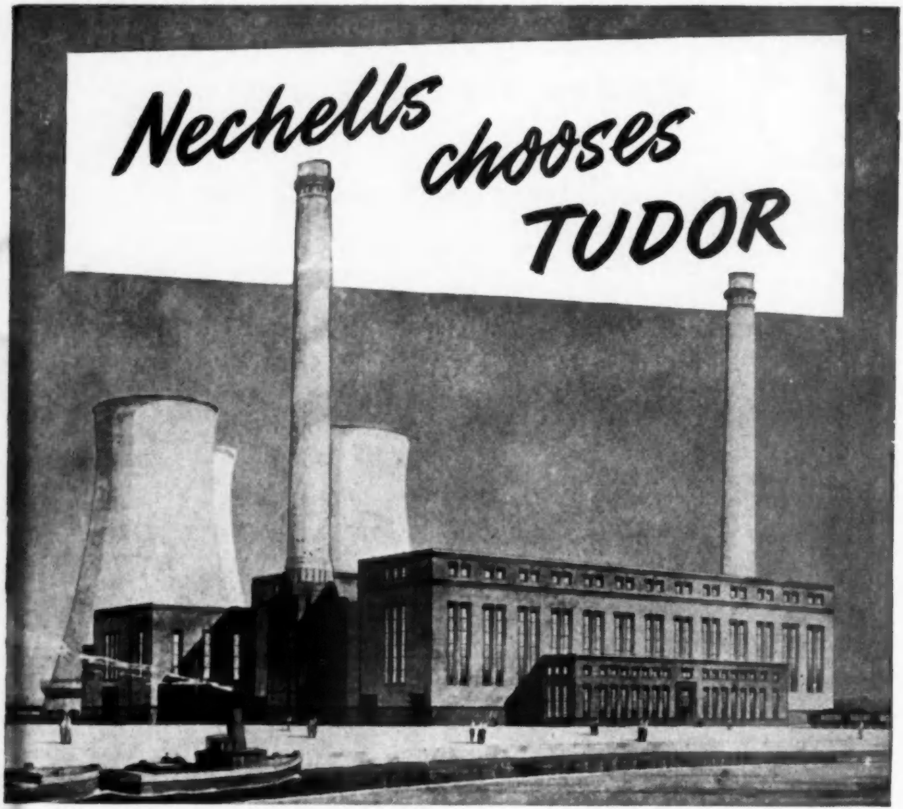
General view of Shanan Power Station

Four three-phase, waterwheel-driven alternators, (horizontal type, 13,333 kVA., 428 r.p.m., 11,000 volt, 50 cycle) installed in Shanan Power Station for the Punjab Government's Uhl River Hydro-electric Scheme.

For all plant required for
Hydro-electric Power Schemes
Consult BTH.

BRITISH THOMSON-HOUSTON
THE BRITISH THOMSON-HOUSTON CO. LTD. RUGBY, ENGLAND

A.[illegible]



Nechells' new Power Station, Birmingham, like other great projects will rely on Tudor batteries. In this it follows the example of many others of Britain's new Power Stations where every item of equipment is rigidly selected on merit.

Please write for publications Nos. 66A/2 & 69D/2.

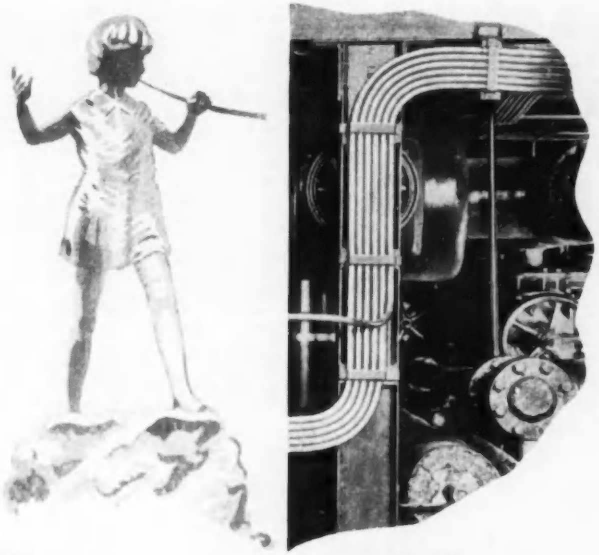
Tudor

BATTERIES

THE TUDOR ACCUMULATOR CO. LTD.,
50 GROSVENOR GARDENS, LONDON, S.W.1

Duplicate batteries will be installed each consisting of **115** *cells in open glass boxes, having a capacity of 600 ampere-hours at the 10 hour discharge rate. The batteries will be used for supplying emergency lighting circuits, indicating, closing and tripping circuits of the main 11 Kv. switchgear and the 3.3 Kv. and 415 volts works supply switchgear.*

T.75



THEY NEVER GROW OLD

Like Peter Pan, "Pyrotenax" M.I. Cables defy time and remain "eternally young." Once installed, they "carry on" without causing any bother or requiring any attention. Oil—water—cutting fluids—condensation—accidental overload—the grossest ill-usage—nothing affects their efficiency. They need neither maintenance nor renewal. In fact, for all practical purposes, "Pyrotenax" M.I. Cables are invulnerable and everlasting. They are fire-resistant and need no conduits. They can be bent to any shape and any form of clip, saddle or clamping device will hold them firmly in position.

ARE GIVING SAFE AND PERMANENT SERVICE IN

Electrical Generating Stations, Factories and Workshops, Aerodromes, Shipyards and Storage Installations, and Buildings of every kind.

PYROTENAX *Cables*
MINERAL INSULATED COPPER COVERED
For LOW TENSION LIGHTING, POWER & CONTROL WIRING

PYROTENAX LIMITED, HEBBURN-ON-TYNE. TEL.: HEBBURN 32244-7
LONDON : 7 Victoria St., S.W.1. Tel. : ABBey 1654-5. BIRMINGHAM : 2 Moor St. Tel. : Midland 1265

FERRANTI

7-Range CLIP-ON AMMETER

FERRANTI CLIP-ON AMMETER
AMPERES A.C.
10
25
50
100
250
500
1000

Thumb-operated switch

Fully insulated

Accuracy within 3% of full scale

Can be applied to bare or insulated conductors up to 2¼ins. diameter

Weight ... 3 lbs.

Delivery from Stock

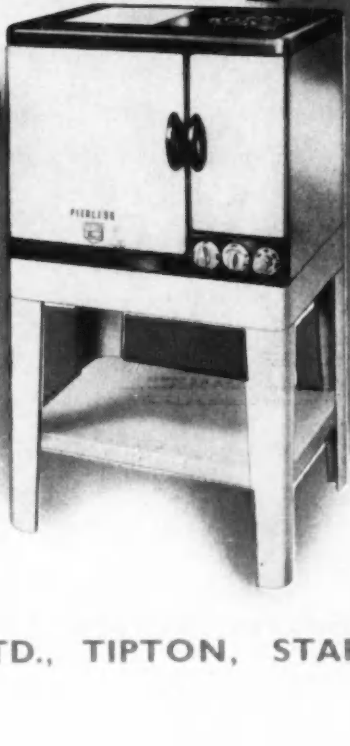
RANGES

0 - 10 Amps.
0 - 25 "
0 - 50 "
0 - 100 "
0 - 250 "
0 - 500 "
0 - 1000 "

FERRANTI

F.I.69

FERRANTI LTD.
HOLLINWOOD LANCS.
London Office: Kern House, Kingsway, W.C.2



For use on
a TABLE
or with a
SPECIAL
STAND

Revo

Here is the
'PEERLESS'
ELECTRIC
COOKER

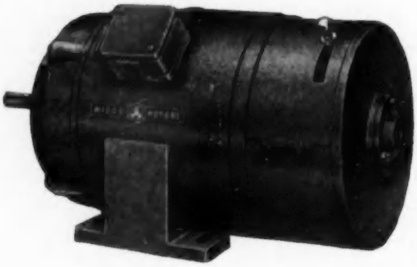
'BIG COOKER' capacity —
'SMALL COOKER'
consumption

A table cooker of unique qualities, providing the facilities of a full-sized model, but so designed to allow for connection to the electric supply by means of a standard 13 or 15 amp. plug.

Equipment comprises a grillboiler with 3-heat switch and a boiling plate with "Simmerstat" control, while the oven is thermostatically controlled by a "Revostat." The cooker is finished in black and cream enamel and may be supplied with or without stand.

REVO ELECTRIC CO. LTD., TIPTON, STAFFS

TRADE MARK
HIGGS MOTORS LTD.
CHAIRMAN WALTER F. HIGGS, M.I.E.E.
BIRMINGHAM 6 ENGLAND



VARIABLE SPEED
Single-Phase
Repulsion Motors
Fully described in leaflet 105
and
GUARANTEED FOR EVER

Belfast, Birmingham, Bristol, Dundee, Glasgow, London, Manchester, Newcastle, Peterborough, Sheffield, Wolverhampton

HE DIDN'T KNOW WHICH WAY TO TURN

Buying this from there and that from somewhere else made his job far more difficult than was necessary. Once he got the friendly tip that he could cut his worries by concentrating his purchasing, things got a lot easier. Now he gets all his Electrical requirements from one organisation. He also gets Service with a smile as well as the benefit of over 40 years' experience. Why not try it yourself?

THE CENTRE OF ELECTRICAL SERVICE

BCE CO. LTD.

E.W.F. ELECTRICAL WHOLESALERS FEDERATION MEMBER

BRITISH CENTRAL ELECTRICAL CO. LTD.
(ESTABLISHED 1908)
(DEPT. T) 6-8 ROSEBERY AVENUE, LONDON, E.C.1
Telephone: TERminus 2525 (6 lines) *Telegrams: "Briticent, Smith, London"*

160-39

CONDUIT FITTINGS
AND
WIRING
ACCESSORIES
METWAY PRODUCTS

We are exhibiting at **British Industries Fair**
Castle Bromwich, BIRMINGHAM
STAND NOS: C.102 AND C.225

METWAY PRODUCTS
Registered Trade Mark

Have you had YOUR copy of this New Catalogue?

92 PAGES
FULLY ILLUSTRATED AND PRICED

Containing no less than 1,800 different types, sizes and finishes.

ASK FOR LIST OH/31/TE

Only applications on printed letter heading can receive attention.

METWAY ELECTRICAL INDUSTRIES LTD.
KING STREET, BRIGHTON, 1
Phone: Brighton 8 66. Grams: 'Metway,' Phone, Brighton

The WORTHINGTON - SIMPSON MONOBLOC

The most modern Centrifugal Pump

Note these Features . . .

Which mean a superior performance over a longer life

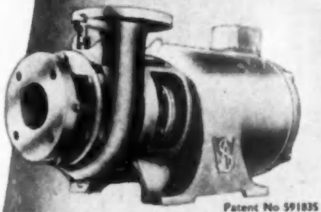
No shaft wear
Separable liquid end
Only one stuffing box
Suction pressure on stuffing box
Hydraulically balanced impeller

Accessibility
Shaft protected from liquid
Quietness in operation
Renewable wearing parts
Choice of materials of construction

. . . and all the outstanding advantages of the Monobloc construction . . .

Pump & motor one unit
Compactness
Easy installation
Few parts
Base integral
Only one shaft

No danger of misalignment
Freedom from vibration
No belts, pulleys or couplings
Horizontal or vertical installation
Low initial cost
Low power consumption

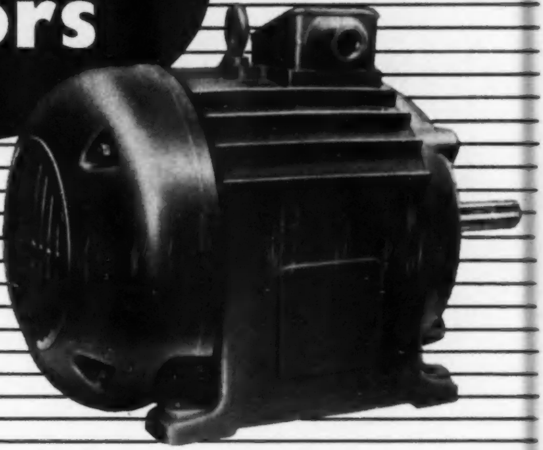


Patent No 591835
Sizes range from 1" to 5" and ½ to 30 B.H.P.
Capacities up to 1200 G.P.M.
and Heads up to 380 Feet.

WORTHINGTON - SIMPSON LTD.
NEWARK, NOTTS.

Greater Efficiency brings lower prices

'ENGLISH ELECTRIC' motors

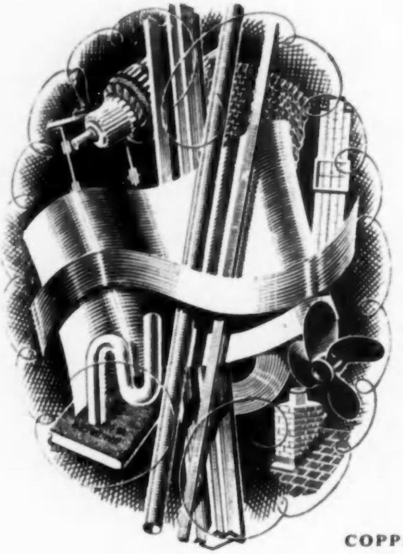


Substantial Reduction in Prices

for Screen-protected and Totally-enclosed fan-cooled Motors up to 15 h.p. The majority of these motors can be supplied ex. stock-24-hours' delivery.

THE ENGLISH ELECTRIC COMPANY LIMITED
INDUSTRIAL MOTOR WORKS - - - - BRADFORD
Works also at STAFFORD · PRESTON · RUGBY · LIVERPOOL

G 50



Helping COPPER to help the nation

COPPER DEVELOPMENT ASSOCIATION exists to promote the wider and more efficient use of copper and its alloys and to bridge the gap between technical developments and their practical application in industry. The C.D.A. is backed by the resources of the whole British copper industry and is in a unique position to help copper to help you, no matter what your interest may be.

The Association, which is a non-trading organisation, can tell you what copper and its alloys can or cannot do and how they can be used to the best advantage. Its services are available to all entirely free of charge or obligation. You have only to ask.

COPPER DEVELOPMENT ASSOCIATION · KENDALS HALL · RADLETT · HERTS · RADLETT 5616

A NEW FUSE-LINK HANDBOOK
Send for a free copy!
BI Callender's
TYPE E
HIGH-BREAKING-CAPACITY
FUSE-LINKS

This new book gives you up-to-date information on BICC High Breaking-Capacity Fuse-Links for 250 and 440 volt circuits.

It contains details of their design, manufacture, range and outstanding characteristics of performance.

Write to-day for a free copy of Publication No. 252V

BRITISH INSULATED CALLENDER'S CABLES LIMITED
NORFOLK HOUSE, NORFOLK STREET, LONDON, W.C.2

DANBY PRODUCTS

SHORT PERIOD TIME SWITCH

TYPE ZN

(as illustrated)

For controlling the short period lighting of corridors, landings, staircases, etc., and suitable for short period operation of industrial and domestic apparatus such as mixers, fans, blowers, hair-dryers, toasters, etc.

also

TIME SWITCH TYPE SN

For controlling shop window lighting, signs, immersion heaters, space heating, battery charging, peak load control.

Descriptive leaflets sent on request. Special timing apparatus manufactured to customers' specification.

TIME SWITCHES & INSTRUMENTS, LTD.

5, Victoria Street, London, S.W.1

TELEPHONE: ABBEY 6903

Many a strong selling line starts out as a

SERCK

TUBE

Solid drawn tubes and sections in non-ferrous metals — copper, brass, etc.

SERCK TUBES LTD., WARWICK RD., BIRMINGHAM

REYROLLE
IN MALAYA

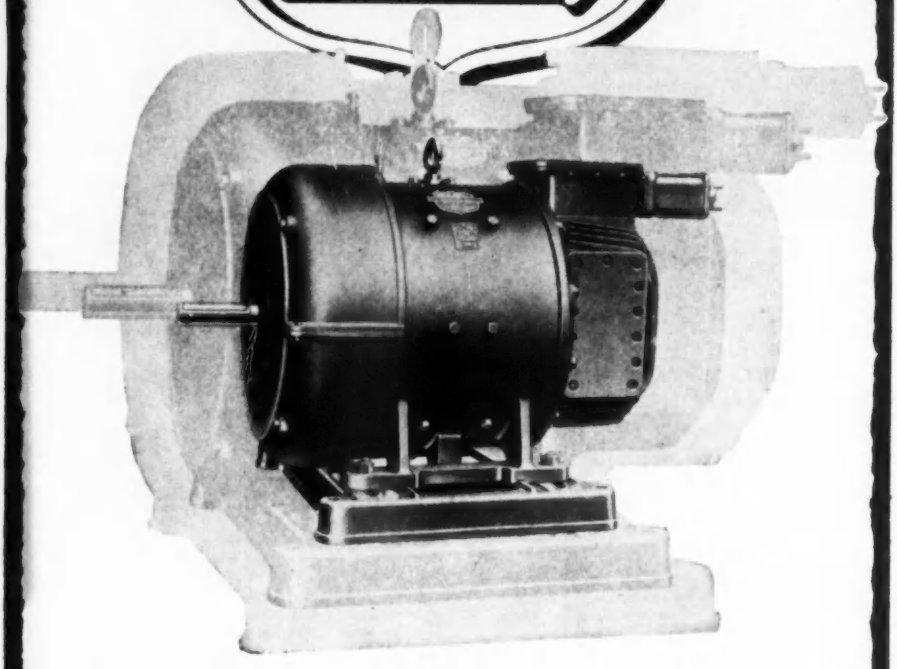
550-volt horizontal drawout metalclad air - insulated switchboard with oil-break circuit-breakers installed at a depth of 1,100 feet in the tin-mine of the Pahang Consolidated Company, Ltd.

INSTALLED IN 1931
FLOODED 1941-1949

AFTER RE-CONDITIONING
BY CUSTOMER'S ENGINEERS **Now back in service**

A. REYROLLE & CO. LTD. HEBBURN ☆ CO. DURHAM ☆ ENGLAND

LDC
FLAMEPROOF

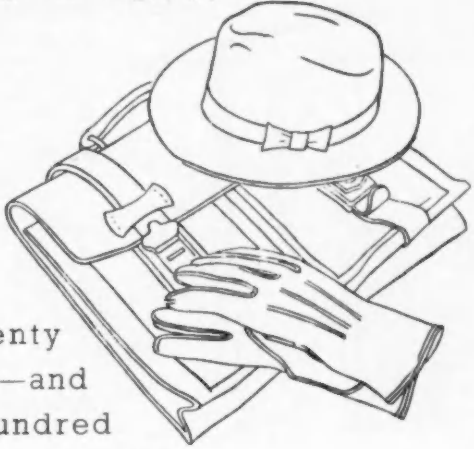


The L.D.C. range of D.C. Flameproof Motors, extends up to 80 H.P.—for A.C., up to 1,100 H.P.

LDC ORGANIZATION
LANCASHIRE DYNAMO & CRYPTO LTD
TRAFFORD PARK MANCHESTER 17
WILLESDEN LONDON N.W.10

Associated Companies:
Foster Transformers & Switchgear Ltd. · Crypton Equipment Ltd. · Crypto Ltd. · Nevelin Electric Co., Ltd.

Pay us a call...



There are twenty places at Home—and more than one hundred Overseas where the word 'Enfield' invites you to pay us a call if you use copper wires, strand, covered wires, paper or rubber insulated cables up to 264 kV. There is an open door at Brimsdown, we shall be pleased to see you—pay us a call—

We'll send you a cable

LONDON, BELFAST, BIRMINGHAM, BRIGHTON, BRISTOL, CARDIFF, GLASGOW, HULL, IPSWICH, LEEDS, MANCHESTER, NEWCASTLE, NOTTINGHAM, SELBY, SOUTHAMPTON and throughout the world.

ENFIELD CABLES LIMITED
BRIMSDOWN, MIDDLESEX.
HOWard 2661 (Works) **London Office: HOLborn 0591**

RADIOVISOR

PHOTO ELECTRIC AND ELECTRONIC CONTROLS

RADIOVISOR

Radiovisor Standard Equipment Includes:

INDUSTRIAL SMOKE INDICATOR · 'FLAMESTAT' FLAME FAILURE CONTROL · AUTOMATIC RADIATION PYROMETER STREET AND FACTORY LIGHTING CONTROL · PRESS BRAKE GUARD RAY · COUNTING AND BATCHING UNIT · HOPPER AND BUNKER LEVEL CONTROL · INVISIBLE LIGHT RAY BURGLAR ALARM CONVEYOR CONTROL · SMOKE DETECTOR FIRE ALARM · ESCALATOR AND LIFT CONTROL · AUTOMATIC DOOR OPENING · TIME AND PROCESS CONTROL · PRINT REGISTRATION CONTROL · RACE TIMING · TURBIDITY INDICATOR · SMOKE ALARM

A Research and Development Department with a competent and experienced staff is at your service. It has helped many large concerns to overcome Control Problems peculiar to their own business.

Full particulars from ....

RADIOVISOR PARENT LTD.

1, STANHOPE STREET, LONDON, N.W.1

Telephone: EUSton 5905/6

Specialists in

NICKEL *and* NICKEL ALLOYS

for every industry

NICHROME

BRITISH DRIVER-HARRIS CO. LTD.

GAYTHORN MILL, ALBION ST., MANCHESTER 15

ALSO AT LONDON AND BIRMINGHAM

OLD KING COAL CALLS FOR HIS

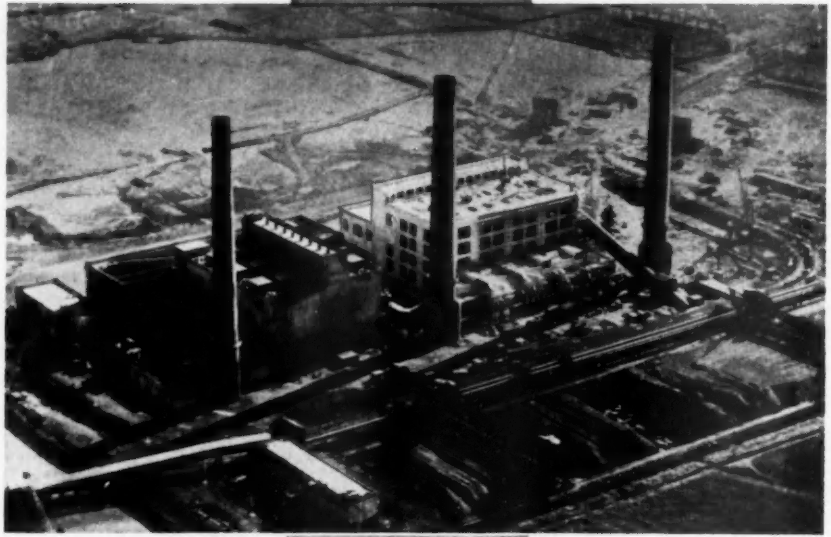
Crompton CABLE

CROMPTON PARKINSON LIMITED, CROMPTON HOUSE, ALDWYCH, LONDON, W.C.2

Telephone CHAncery 3333 *Telegrams: Crompark, Estrand, London*

CROMPTON CABLES

POWER IN THE MAKING



SG.5

No. 5—Littlebrook Generating Station

Three 'International' pulverised fuel fired boiler units each with an output of 260,000 lbs. steam per hour at 625 psi and 825 F were set to work in 'A' Station in 1939. The efficiency of pulverised fuel firing led to further applications of the system and four more 'International' pulverised fuel fired radiant boilers working at 1,310 psi and 850 F with re-heat were supplied for 'B' Station.

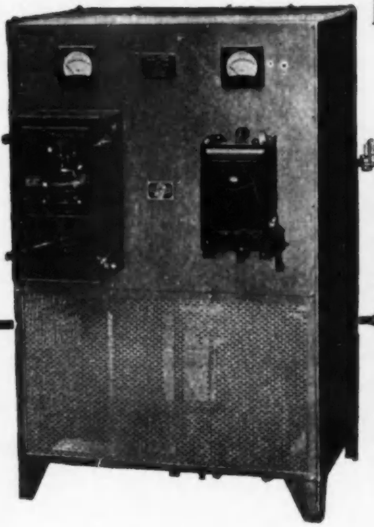
Littlebrook is being extended still further by the building of 'C' Station which when completed will have six larger 'International' boilers, again fired with pulverised fuel. These boilers will be working at 975 psi and 915°F, each having an evaporation of 360,000 lbs. steam per hour.

All the 'International' boilers at Littlebrook have completely water-cooled combustion chambers and they are all tangentially fired, those in 'B' and 'C' Stations incorporating tilting burners which provide in effect an adjustable furnace with all the resultant advantages. Features such as these have enabled pulverised fuel firing to attain the premier position it now occupies in the field of steam generation.

ICL

INTERNATIONAL COMBUSTION LTD

London Office: NINETEEN WOBURN PLACE, W.C.1
Works: DERBY, ENGLAND; PORT ELIZABETH, SOUTH AFRICA; SYDNEY, AUSTRALIA



Selenium Rectifiers

For every application where Low or Medium D.C. Output is required from A.C. Mains

EFFICIENCY and maximum dependability are ensured by the selection of a Crypton Selenium Rectifier for any application where D.C. power is required from A.C. supply mains.

Rectifiers are available for all applications, including Battery Charging, Electro Plating, D.C. Motor Supply, Magnetic Chucks and Separators, Laboratory Service and all the many additional applications for which Selenium Rectifiers can advantageously be employed.

An interesting new catalogue is now available—a copy will be gladly forwarded on request.

CRYPTON
SELENIUM RECTIFIERS

LDC ORGANIZATION

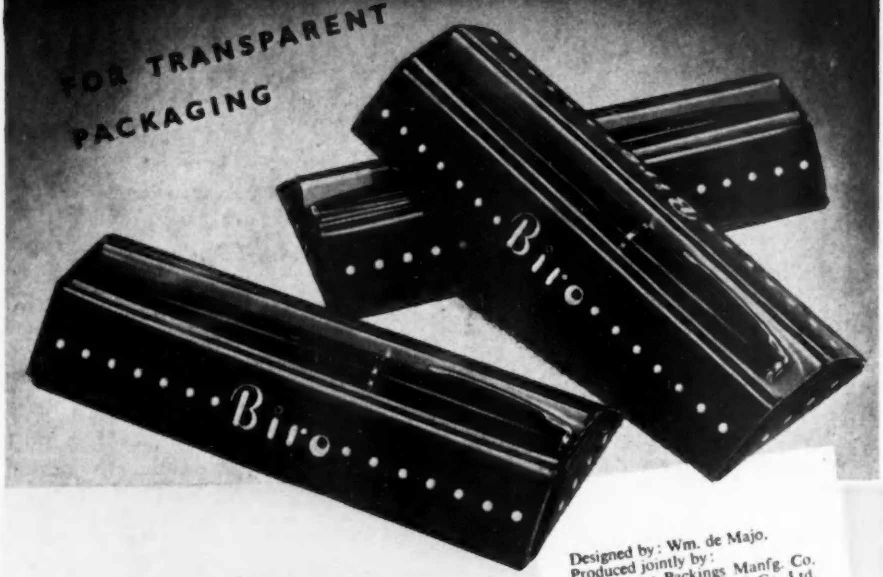
CRYPTON EQUIPMENT LTD
BRIDGWATER SOMERSET

Associated Companies: Lancashire Dynamo & Crypto Ltd. Crypto Ltd. Foster Transformers & Switchgear Ltd.

Biro HAS VISION . . IN CRYSTAL CLEAR

'Clarifoil'

TRADE MARK



Designed by: Wm. de Majo.
Produced jointly by:
Transparent Packings Manfg. Co. Ltd. and Richard Pye & Co. Ltd.
'Clarifoil' for vision packaging by:
British Celanese Limited.
By courtesy of The Miles-Martin Pen Co. Ltd.

The Biro pen is one of many products that profit from Clarifoil's crystal clarity as an overwrap. Clarifoil gives added sales appeal and protection to a wide range of goods— from clothes to cosmetics, from groceries to textiles. Tough, flexible, waterproof and greaseproof, Clarifoil is printable in multi-colours; can be laminated to metal foils, to paper and paper-board.

The services of our Laboratory of Applied Plastics are freely available for consultation and, where possible, for practical demonstrations. Enquiries to:

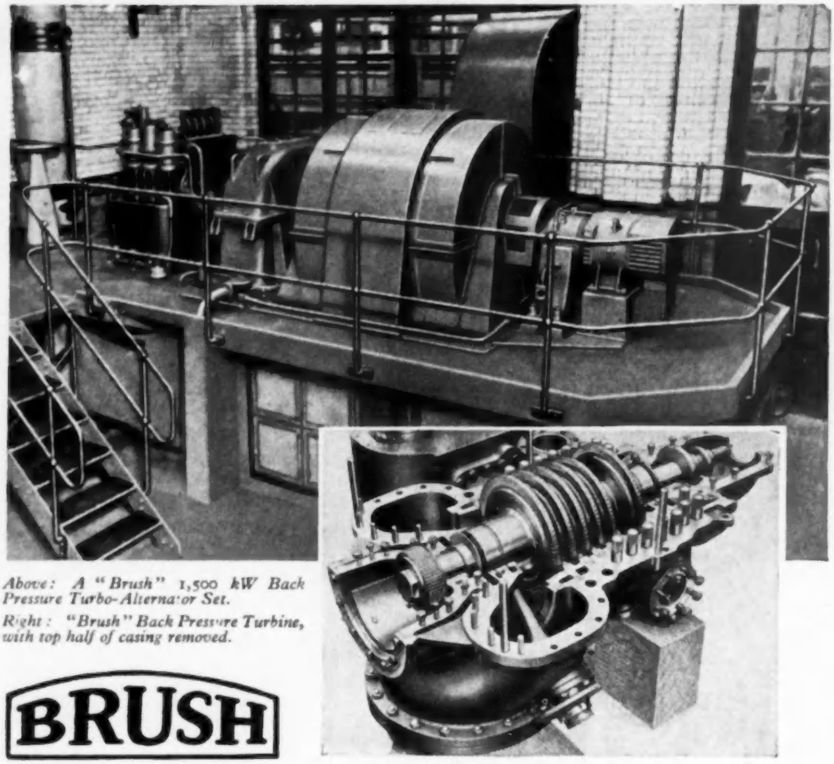
BRITISH CELANESE LIMITED

Plastics Division, Celanese House, Hanover Square, London, W.1.

TEMCO wiring accessories are available in
WHITE

List numbers are clearly quoted in our Accessory Catalogue, a copy of which will be sent on request

T. M. C.-HARWELL (SALES) LTD
37 UPPER BERKELEY ST., LONDON, W.1 *Telephone:* Paddington 1867-8-9



Above: A "Brush" 1,500 kW Back Pressure Turbo-Alternator Set.

Right: "Brush" Back Pressure Turbine, with top half of casing removed.

BRUSH

Power from Process Steam

Steam used for processing or heating buildings can be used to provide very cheap power, if passed through a suitable turbine. A range of new high-efficiency Brush Axial-Flow Turbines is now available for industrial applications and our technical engineers would be pleased to assist in solving your power plant problems.

★ **Our publication "Power from Process Steam" will interest you, write for a copy to:**

THE BRUSH ELECTRICAL ENGINEERING CO. LTD., LOUGHBOROUGH, ENGLAND

Branches: London · Birmingham · Manchester · Leeds · Cardiff · Newcastle · Glasgow

14.23

IN THE AIR
BRABAZON
CARONIA
AT SEA
BATTERSEA POWER STATION
ON THE GROUND

WESTINGHOUSE

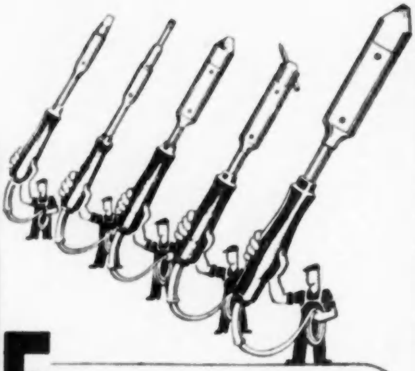
WESTALITE

RECTIFIERS

wherever they are installed maintain their reliability and efficiency for which they are famed, and carry on for years without replacement and are trouble free

Write for Data Sheet No. 1 to Dept. E.T.5

WESTINGHOUSE BRAKE & SIGNAL CO, LTD
82, YORK WAY, KINGS CROSS, LONDON, N·1



5 SOLON MODELS

SOLON electric soldering irons have proved their capacity for continuous service under the most exacting conditions. 5 models; 240 watt oval tapered bit; 125 watt oval tapered and round pencil bits and 65 watt oval tapered and round pencil bits. Each model complete with 6 feet of Henley 3-core flexible. Now available from stock. Write for folder Y.10.

HENLEY
SOLON
TRADE MARK
ELECTRIC
SOLDERING IRONS

W. T. HENLEY'S
TELEGRAPH WORKS CO. LTD.
51-53 Hatton Garden, London, E.C.1

THE "FLUXITE QUINS" AT WORK.

"I soon put the old loco right,
Fixed up the leak with FLUXITE."
"You've done it!" yelled EE,
"'Twas no leak! You'll soon see!
T'was her safety valve! Gosh what a sight!"

For all SOLDERING WORK—you need FLUXITE—the paste flux—with which even dirty metals are soldered and "tinned." For the jointing of lead—without solder; and the "running" of white metal bearings—without "tinning" the bearing. It is suitable for ALL METALS—excepting ALUMINIUM—and can be used with safety on ELECTRICAL and other sensitive apparatus.

With Fluxite joints can be "wiped" successfully that are *impossible by any other method.*

Used for over 40 years in Government works and by leading Engineers and Manufacturers. OF ALL IRONMONGERS in tins—10d., 1/6 and 3/-. THE FLUXITE GUN puts FLUXITE where you want it by a simple pressure. Price 2/6, or filled 3/6.

FLUXITE

SIMPLIFIES *ALL* SOLDERING

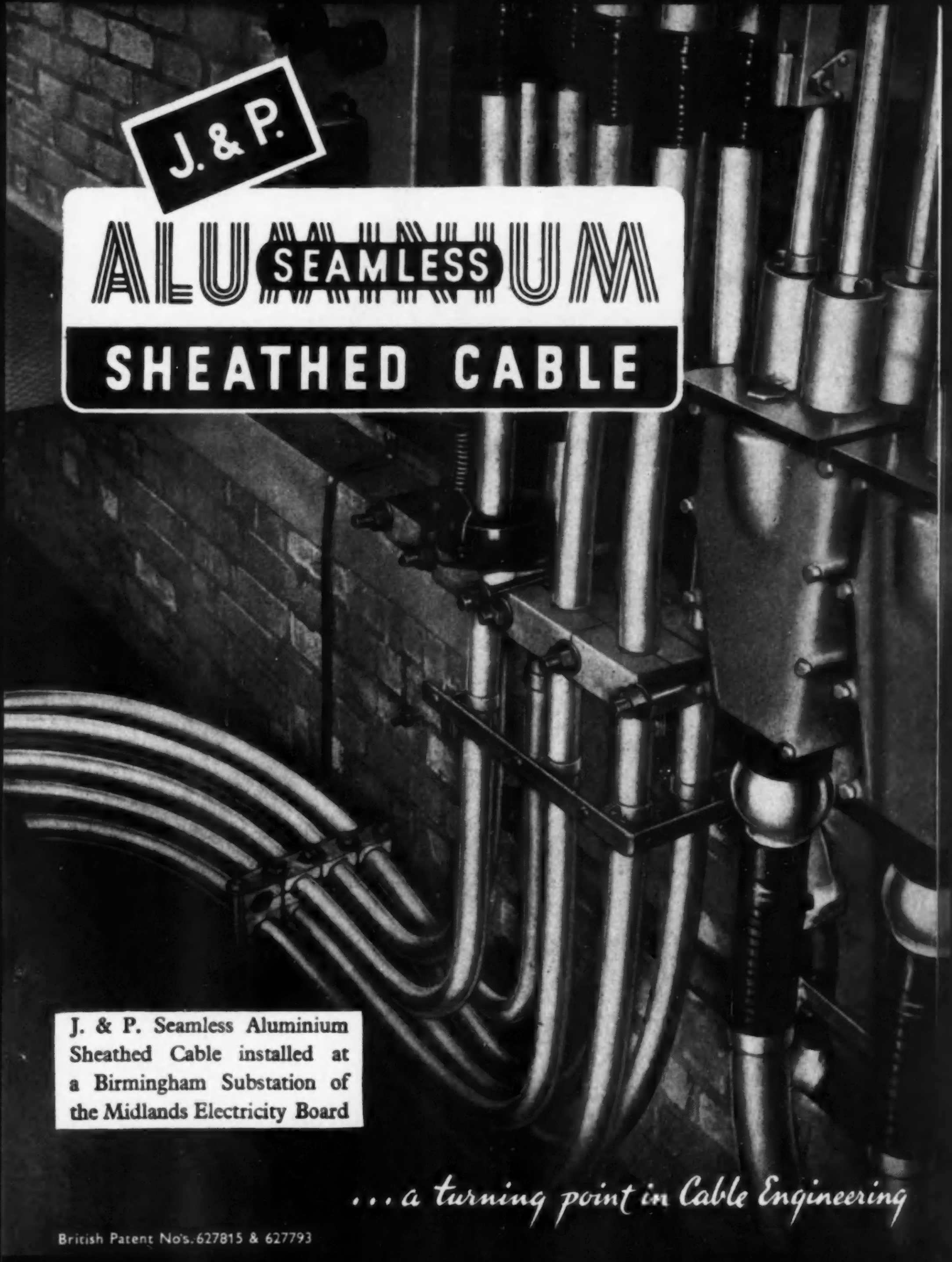
Write for leaflets on case-hardening steel and tempering tools with FLUXITE also on "Wiped" joints. Price 1d. each.
FLUXITE LTD. (Dept. E.T.), Bermondsey St., S.E.

PERFORATED METAL . . .

for
Covers and Panels
on Electrical
Machinery, Equip-
ment and Motors

ASH and LACY Ltd
MERIDEN ST · BIRMINGHAM 5

2515 B



J. & P.

ALUMINIUM SEAMLESS SHEATHED CABLE

J. & P. Seamless Aluminium Sheathed Cable installed at a Birmingham Substation of the Midlands Electricity Board

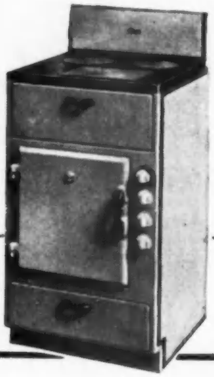
. . . a turning point in Cable Engineering

British Patent No's. 627815 & 627793

JOHNSON & PHILLIPS LTD.

CHARLTON LONDON S.E.7

The mark that means that "little more" in quality



CARRON 'H.3' ELECTRIC COOKER

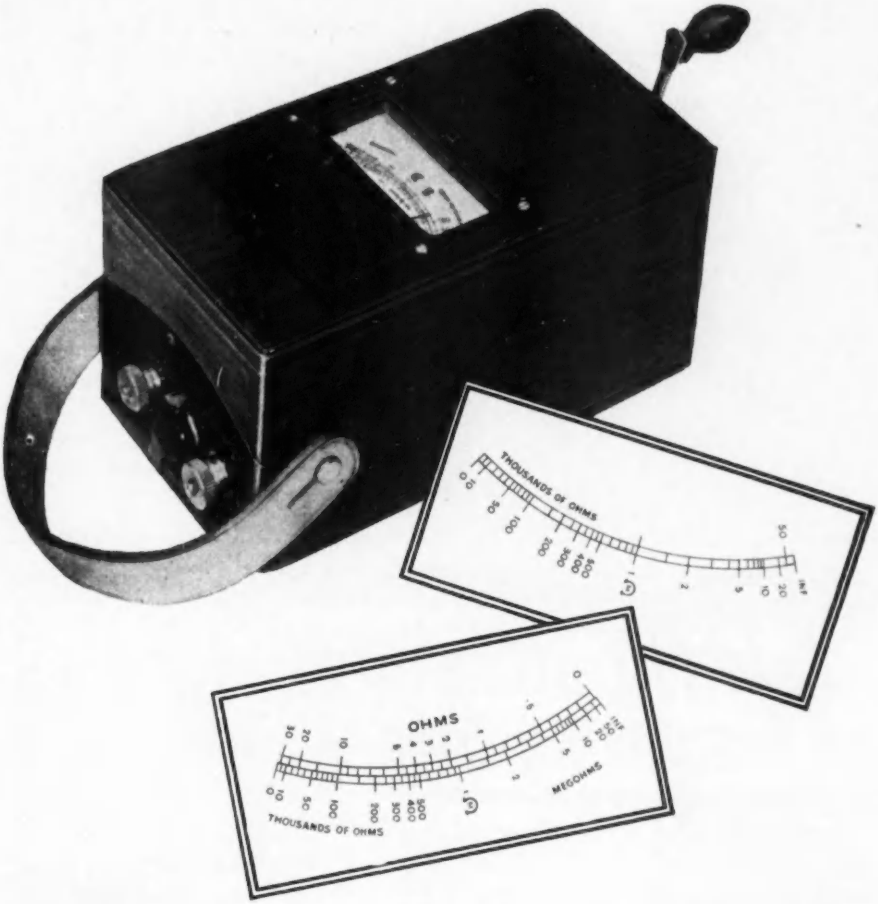
Hob structures to E.D.A. Specification • Extra large oven, thermostatically controlled • Self-indicating reciprocating switches • Easy access to fuses • Modern clean design • Strongly constructed of cast iron and sheet steel, finished in vitreous enamel. Write for full technical details and prices.

CARRON

CARRON COMPANY, CARRON, FALKIRK, SCOTLAND
Showrooms: 15 *Upper Thames St., London, E.C.4*
22-26 *Redcross St., Liverpool* 1. 125 *Buchanan St., Glasgow, C.*1

This is a CARRON product made by modern CARRON processes embodying the CARRON tradition for fine workmanship begun in 1759.

THE "MAJOR" INSULATION TESTER


THOUSANDS OF OHMS
0
10
50
100
200
300
400
500
1
2
5
10
20
50
INF
OHMS
30
20
10
6
4
3
2
1
.5
0
MEGOHMS

a RECORD instrument

Compact and light in weight, this latest addition to the Record family has a Constant Pressure generator of patent design. Ranges up to 500 volts 50 megohms with or without Continuity range of 0/30 ohms are available. Send for descriptive leaflet D/b.

THE RECORD ELECTRICAL CO. LTD., BROADHEATH, ALTRINCHAM, CHESHIRE

Phone: Altrincham 3221/3. Grams: "Infusion" Altrincham. London Office: 28 Victoria St., S.W.1 Phone: Abbey 5148

THAT EXTRA APPLIANCE-

Your Customer can have it

—WITHOUT EXTRA SOCKETS—

IF YOU GIVE HER

WYLEX

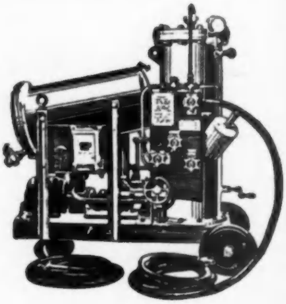
The Plugs and Sockets for

EXTRA CUSTOMER CONVENIENCE

Write for:

Explanatory Booklet of "Wylex" Dual Plugs.

GEORGE H. SCHOLES & CO. LTD.
WYLEX WORKS, WYTHENSHAWE, MANCHESTER.



Cold Filtration of Insulating Oils

The insulating value of used transformer and switch oils by one passage through the Metafilter is raised to a higher break-down voltage than the new oil.
The plant is purely mechanical and extremely simple in operation.

Capacities from 20 gallons to 1,000 gallons per hour.

METAFILTRATION

PHONE: HOUNSLOW 1121/2/3
GRAMS: METAFILTER, HOUNSLOW

THE METAFILTRATION COMPANY LIMITED, BELGRAVE ROAD, HOUNSLOW, MIDDLESEX

SIEMENS
LAMPS
Evidence of Good Lighting
SIEMENS GASFILLED
BRITISH MADE

The two Siemens Preston Factories are equipped to produce lamps for every lighting purpose, the new Factory having been designed expressly for the manufacture of fluorescent powders and lamps.

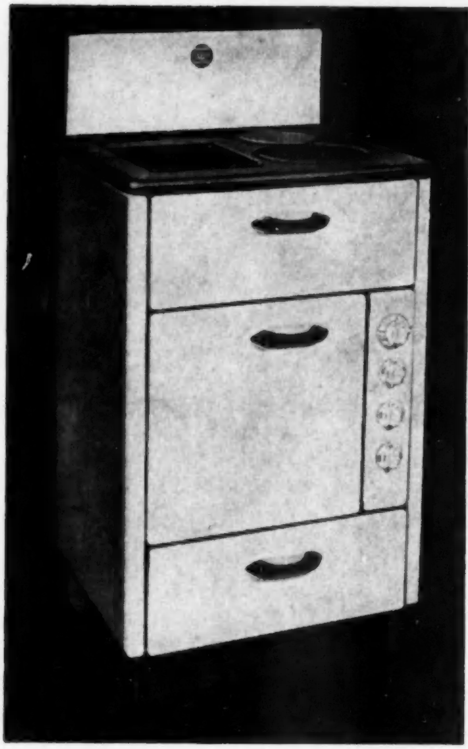
A successful addition to the popular range of Siemens "Sieray" Fluorescent Lamps is the "MELLOW LIGHT" which has been developed to provide added charm to the complexion, food, fabrics, etc.

Price 15/6 each plus P. Tax 4/-
RATING 5ft 80W
(For use in Instant Start Circuits **16/6** *each plus P. Tax* **4/3***)*

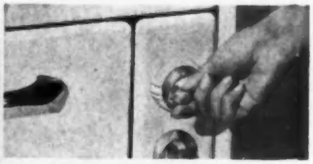
Advt. of SIEMENS ELECTRIC LAMPS AND SUPPLIES LIMITED, 38 39 Upper Thames Street, London, E.C.4
Branches at-Belfast, Birmingham, Bristol, Cardiff, Dublin, Glasgow, Leeds, Liverpool, Manchester, Newcastle-on-Tyne, Nottingham, Sheffield.

These 12 features explain why the **FALCO Cooker** *is such a favourite . . .*

FIRST impressions are important—and this electric cooker delights the housewife at once with its good-to-look-at, easy-to-clean design. When she learns all the Falco can *do*, she is even more enthusiastic, for its self-controlled heat means the end to so much fuss and bother. The Falco has *every* virtue a modern electric cooker can possess:

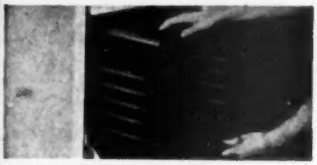


This is the **Falco No. 16** with 3 cooking plates and a utility drawer at the bottom for cooking utensils . . . **Falco No. 15** is the same but has 2 cooking plates . . . **Falco No. 17** is the same but has 2 cooking plates and no utility drawer.



1 Self-indicating switch handles.

2 Quickly dismantled for cleaning.



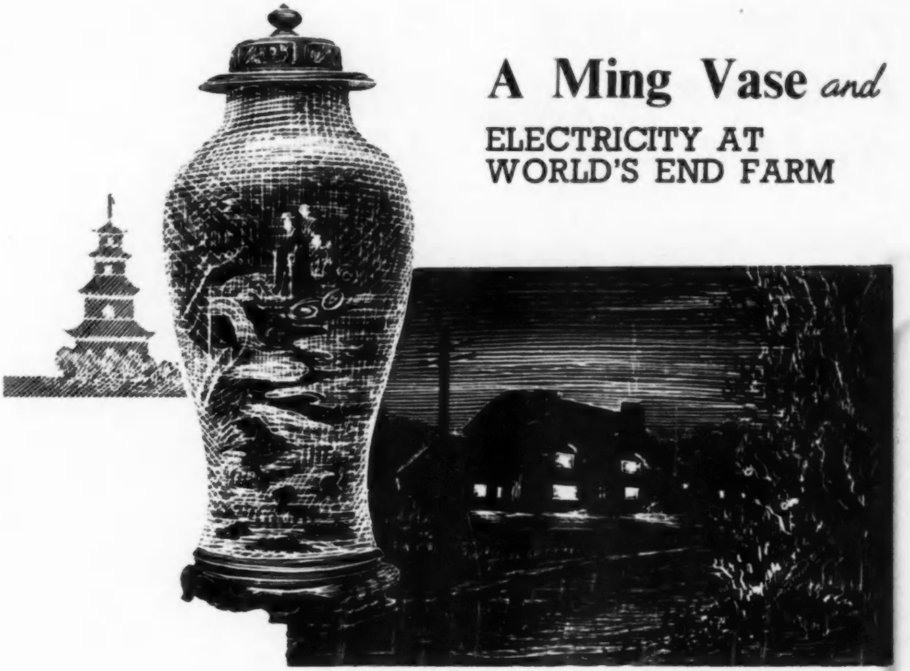
3 Round-cornered, removable oven—unscrew a nut and out it comes bottom, sides and top for easy cleaning.
4 Clean-line design.
5 Cream, cream and green, white or light grey mottled vitreous-enamel finish.
6 Thermostatic oven control.
7 Simmering control on boiling plate of models 15 and 16.
8 E.D.A. interchangeability.
9 Fuses.
10 Plug-in oven elements.
11 Spring controlled drop-down oven door.
12 First class electrical and mechanical construction.

FALCO ELECTRICAL APPLIANCES LIMITED

Note New Address
CORPORATION ROAD, AUDENSHAW, MANCHESTER
Proprietors: ALLIED IRONFOUNDERS LIMITED

A Ming Vase *and*

ELECTRICITY AT
WORLD'S END FARM



When you leave Marston Moor, by Uffcliffe, World's End Farm lies in the fell below, and on a Winter evening it is good to see the lights blooming in its windows like pale, golden flowers, for you know that merely a few miles further on is the village, and journey's end . . .

Electricity has meant a lot to " World's End "; in the Farms and Outbuildings it has made all kinds of modern equipment available ; and in the house it has banished forever the toil and drudgery of oil stoves and lamps, and made available a host of labour saving devices to lighten the daily tasks.

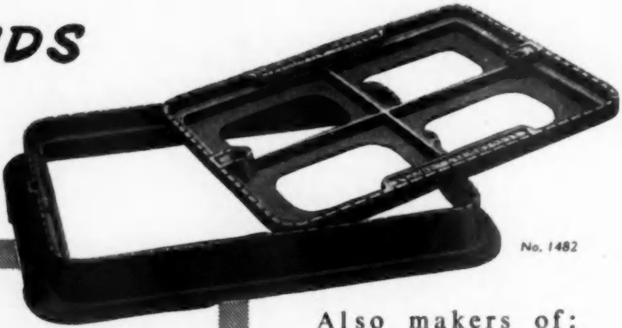
And the Ming Vase, strange as it may seem, that too, played its part in bringing electricity to World's End, for the porcelain from which it was fashioned nearly six hundred years ago is still the same basic material used in T.T. insulation today. So it is, that a secret of ancient China, nearly fourteen centuries old, makes possible the giant insulators of the Grid System carrying electricity to outlying country districts—the current that keeps the windows of " World's End " shining brightly against the leaden skies of Winter.

**TAYLOR,
TUNNICLIFF
PORCELAIN**

Keeps Electricity in its place

TAYLOR, TUNNICLIFF & CO. LTD. *Head Office* : EASTWOOD · HANLEY · STAFFS · **Stoke-on-Trent 5272-4**
London : 125 HIGH HOLBORN, W.C.1. *Holborn* 1951 *Factories at : Hanley, Stone and Longton, Staffs.*

THOUSANDS
have been
SOLD...


No. 1482

ROUND CORNERED PAVEMENT COVERS AND FRAMES

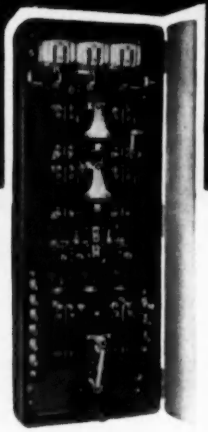
16 Standard Sizes

Also makers of:
Roadway Covers and Frames · Lamp Pillars and Brackets · Kiosks and Pillar Casings

ESTABLISHED 1814

HARDY & PADMORE LTD., WORCESTER. Tel: WORCESTER 3215

M-W.101



IGRANIC ELECTRIC CONTROL GEAR

GET BETTER STARTER PERFORMANCE BY INSISTING ON IGRANIC FOR YOUR VERY NEXT STARTER INSTALLATION

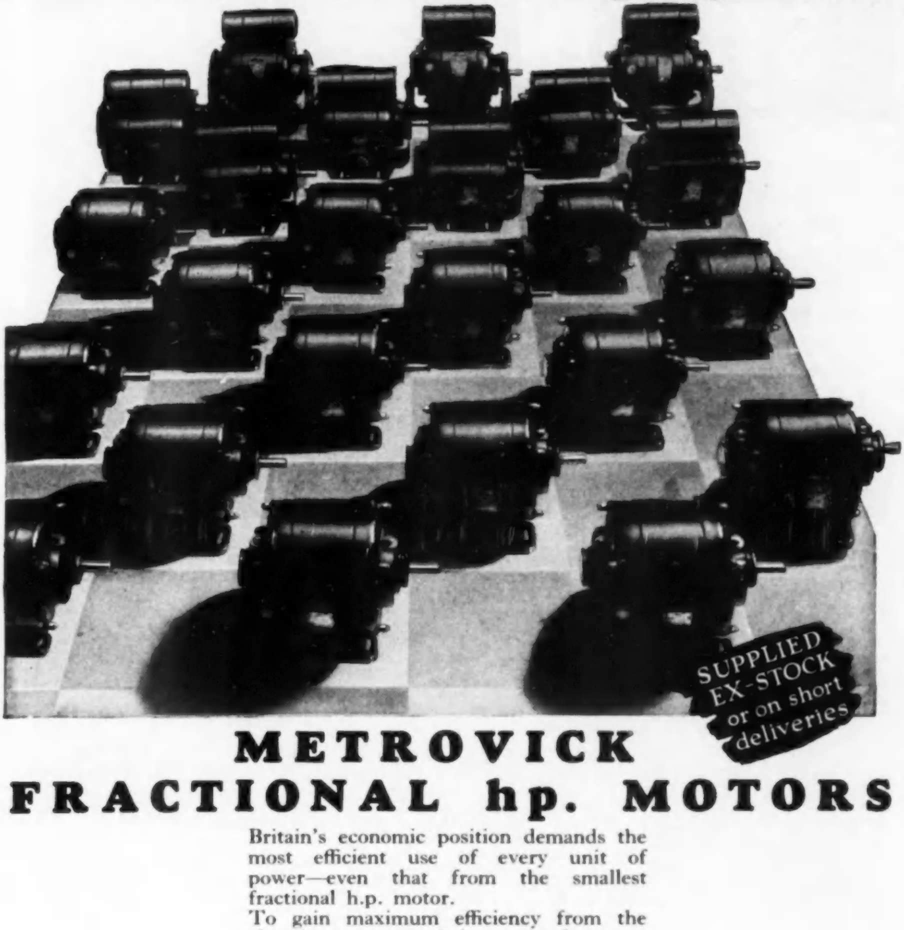
Illustration shows class 82311/1 STAR DELTA STARTER for 7½ h.p. maximum . . . one of a large range of STANDARD starters that are SPECIALLY engineered throughout.

ELECTRIC IGRANIC CO. LTD.

HEAD OFFICE AND WORKS . . . BEDFORD

DISTRICT OFFICES: LONDON - BIRMINGHAM - BRISTOL - CARDIFF
GLASGOW - LEEDS - MANCHESTER - NEWCASTLE - SHEFFIELD

ECONOMIC POWER
for immediate employment



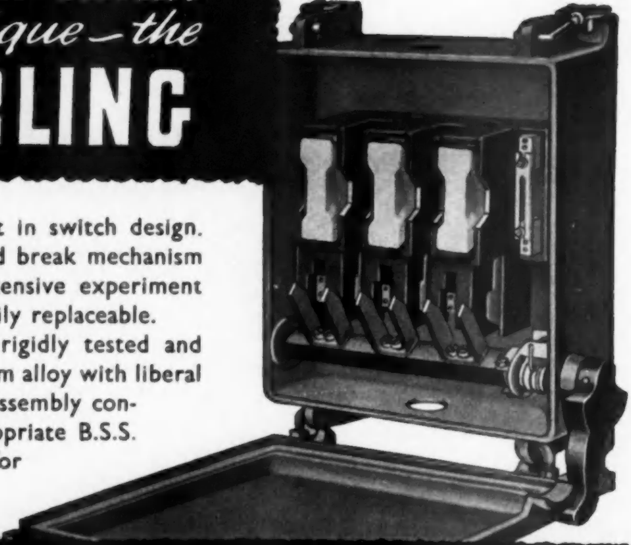
METROVICK
FRACTIONAL hp. MOTORS

Britain's economic position demands the most efficient use of every unit of power—even that from the smallest fractional h.p. motor.
To gain maximum efficiency from the electric power used in your plant you cannot do better than specify motors by Metrovick. Made in sizes from 1/50th to 25,000 h.p.—and upwards.

METROPOLITAN - VICKERS ELECTRICAL CO. LTD.
TRAFFORD PARK, MANCHESTER 17

J/Q001

The new switch technique—the
STIRLING



HERE is the latest in switch design. Quick make and break mechanism is the result of extensive experiment and all parts are easily replaceable.

Fuses have been rigidly tested and cases are of aluminium alloy with liberal wiring room. The assembly conforms fully to appropriate B.S.S. A.C. only. Write for List STI.

DORMAN & SMITH LTD · MANCHESTER · 5

ET.IF50

HGE
Electric
TIME SWITCHES
FOR PUBLIC LIGHTING & INDUSTRIAL & DOMESTIC USE

MANUFACTURED BY
THE HORSTMANN GEAR CO., LTD.
NEWBRIDGE WORKS BATH ENGLAND
TELEPHONE: BATH 7241 TELEGRAMS: HORSTMANN BATH

(British Railways Photograph)

THE LIVERPOOL-SOUTHPORT LINE

The recent re-equipment of this line, one of the earliest conversions from steam, is of particular interest.
The original rolling stock, 10 feet, was the widest ever run in this country.
The elaborate arrangements made to ensure continuity of supply are a feature of this reconstruction.
C.M.A. cables were used originally and are still used throughout the system.

MAINS CABLE MANUFACTURERS ASSOCIATION
RUBBER & THERMOPLASTIC CABLE MANUFACTURERS ASSOCIATION
Affiliated to
CABLE MAKERS ASSOCIATION
52-54 High Holborn, London, W.C.1. Tel: Holborn 7633

Burco

ELECTRIC WASHBOILER

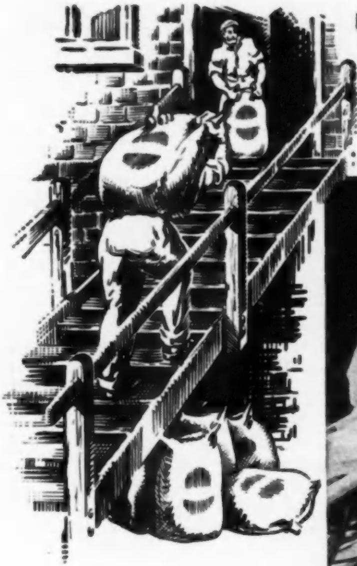
CAT. NO.
E840

This "Burco" model represents absolute perfection in Washboiler design. Every detail of manufacture is embodied to ensure a long, trouble-free life and handsome appearance.
Like every "Burco" model, Cat. No. E840 is a product of years of specialisation.

ALL ENQUIRIES TO

BURCO LTD

ROSE GROVE · BURNLEY · LANCS



THERE'S A BETTER WAY

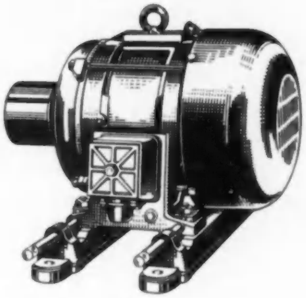
Portable sack elevator with chain drive from a 3 h.p. 750 r.p.m. Surface Cooled motor.

Why carry sacks upstairs? A motor-driven elevator will do the job more economically and save your valuable man-power.

USE AN ELECTRIC MOTOR . . . and MAKE SURE IT'S A BROOK.

A varied and comprehensive range of A.C. motors from 0.25 to 200 h.p.

Brook Industrial Motors have C.S.A. approval



BROOK MOTORS Ltd

EMPRESS WORKS HUDDERSFIELD

I.HK.139

In the shop for a day
. . . In the home for a LIFETIME

"POPULAR" MODEL
"KITCHEN" VITREOUS ENAMELLED
COMBINED KETTLE & SAUCEPAN
"ROYAL" MODEL

These four Electric Kettles are taken from the popular Swan Brand range of Electrical products. Send for leaflets.

SWAN BRAND
BRITISH MADE

ELECTRICAL APPLIANCES
ALUMINIUM HOLLOWARE

Identified by the Quality

BULPITT & SONS LTD. St. George's Works, Icknield St., Birmingham 18

M-W.147B

ELECTRICAL TIMES

FIFTY-NINTH YEAR OF PUBLICATION

Volume 117 No. 3043 . THURSDAY, 2 MARCH 1950

PUBLISHED EVERY THURSDAY

PAGE

NETWORK ANALYSIS 307

OUR READERS' VIEWS 312

NEW STEAM CYCLE 314

B.E.A. 275 kV LINE 317

THE ECONOMICS OF SAFETY 319

OVERSEAS NEWS 322

PERSONALITIES IN THE INDUSTRY 324

UNDERTAKINGS' STATISTICS FOR 1947-48 326

NEW LITERATURE 326

LOW-VOLTAGE SHORT CIRCUITS 327

PROBLEMS AND PRACTICE IN ENGINEERING 333

BUSBAR ZONE PROTECTION 335

THE ARTS AT THE I.E.E. DINNER 338

BRITISH STANDARDS 334

THE BUYER'S COLUMN 339

THE WEEK IN NEWS 341

  Cases in Court 345

  Electric Supply News 346

  Company Activities 347

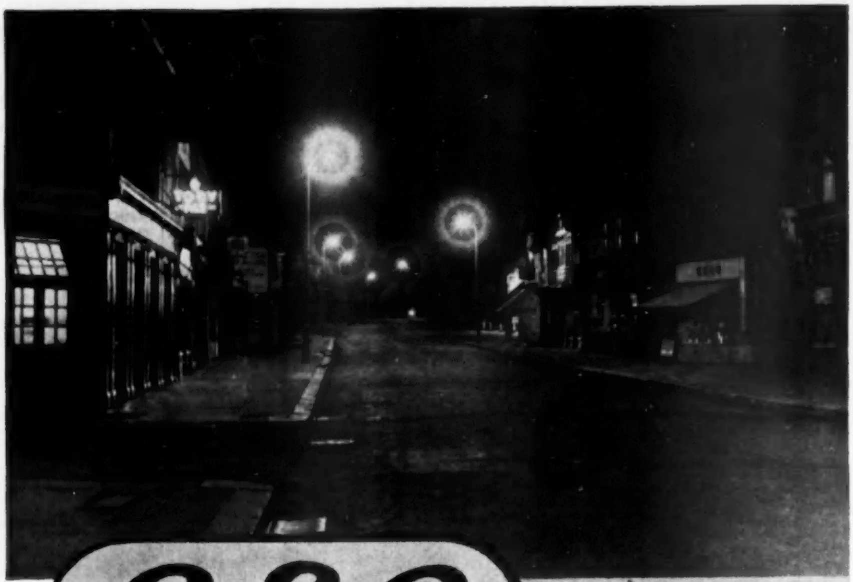
COMMERCIAL INFORMATION 348

CLASSIFIED ADVERTISEMENTS 47

INDEX TO ADVERTISERS 54

SUBSCRIPTION RATES.—United Kingdom and Overseas £1 15s. per annum. Canada C$6, U.S.A. $5 per annum. Subscriptions are payable in advance and may commence with any issue throughout the year. Overseas subscriptions may be paid to The Electrical Times Limited by banker's draft, cheque or international money order. Single copies 6d. each.

OFFICES — SARDINIA HOUSE, SARDINIA STREET, LONDON, W.C.2
Telephone - HOLborn 6016 - Telegrams - Equivolt, Estrand, London



G.E.C.

MAIN ROAD LIGHTING *at* LOUGHTON

This illustration shows a part of the lighting installation at Loughton, where 128 G.E.C. Dioptrion lanterns using 250 watt H.P.M.V. Osram lamps are used. This installation covers approximately three miles, commencing at Buckhurst Hill, running through Epping Forest and Loughton.

THE GENERAL ELECTRIC COMPANY, LIMITED, MAGNET HOUSE, KINGSWAY, LONDON, W.C.2

Editorial

A NEW HEAT CYCLE

THE Field steam cycle, described elsewhere in this issue, seems to offer such phenomenal gains in thermal efficiency, that it is only natural to subject it to the closest examination. The most obvious criticism is the high capital cost, since with its two turbines and compressor, it requires an estimated equivalent of 190 MW of rotating plant for each 100 MW of output. The cycle has also been criticised on the grounds of over-optimistic assumption of efficiencies for the individual stages, particularly in the matter of wet compression, and it has been suggested that the cumulative effect of these small discrepancies would reduce considerably the attractiveness of the proposition.

Other points arise from a consideration of this novel arrangement. The question of heat transfer to the steam suggests that considerable heating surface will be required, so that the final design of the furnace may resemble more closely a Loeffler boiler than a gas turbine combustion chamber, particularly as the proposed pressures do not exceed 1,000 lb/sq in. However, the whole originality of the concept is a little breath-taking, and the discussion on the paper seemed to confirm the view that time is required to digest this heavy meal.

ITS PRACTICAL APPLICATION

A surprising feature of Mr. Field's paper was the amount of stress placed on the supply of steam for process heating. While the application of this new cycle to such systems appears to be ideal, nevertheless it is by the fundamental closed circuit steam pumping section that the new cycle will stand or fall. The paper even breaks into the field of railway traction with the suggestion of direct drive to the wheels, which goes far beyond the original scope of this thesis. But when all criticisms are made, this new cycle remains an outstanding piece of original thinking. Its possibilities are so spectacular, with the estimated consumption of two-thirds of a pound of coal per kilowatt hour, that whatever may be the practical difficulties, we cannot afford to neglect giving it the closest theoretical examination and experimental trial.

P.M.E. IS FAVOURED

ONCE more an investigation into the problem of earthing in rural areas has resulted in the endorsement of protective multiple earthing of the neutral. In reaching this conclusion Mr. Gosland and his E.R.A. associates have navigated their ship through a sea of speculation in which the rocks, though charted, do not seem to be fixed any too accurately. Safety from shock was the criterion, although protagonists of the earth leakage circuit-breaker were not slow to claim that their device scores over P.M.E. on the count of fire risk. Be that as it may, the establishment of firm statistics on the question of earthing is a welcome step, and some important conclusions have resulted. Perhaps that which is likely to have the most immediate practical effect is the claim that money could be much better spent on maintaining existing earth systems than on attempting to secure slightly better conditions by increased expenditure on earth electrodes, and then letting the apparatus look after itself; that earth continuity conductors will fail all unnoticed, at some later date, seems only too probable.

WHO OWNS THE EARTH?

PURCHASE of safety was Mr. Gosland's watchword, and he claimed to show that on a basis of "pound sterling per safety unit" P.M.E. scores heavily. It seems, though, that a further price has to be paid in the form of headaches for the supply engineers. Except for the substation neutral connection, earthing has so far been the consumer's responsibility, and widespread adoption of P.M.E. in developing rural systems would throw on area boards not only the onus of providing good earths, but, far more worrying, of maintaining them, since deterioration of individual consumers' earths would have a generally detrimental effect on the safety of the system as a whole. Thus the administrative side of electricity supply may find P.M.E. unattractive, whatever its engineering merits. But protection against accidents is becoming increasingly recognised as a national responsibility, and it is to be hoped that such considerations will not prevent the wider application of neutral earthing, provided mature consideration of its merits confirms Mr. Gosland's conclusions. Any step that may at once increase the safety and reduce the cost of rural supply must not be lightly dismissed.

E.D.A.'S MUSEUM

THE suggestion made by E.D.A. regarding the establishment of a museum for obsolete domestic apparatus is one which deserves widespread support. Early scientific apparatus may find its way to the I.E.E. or the Science Museum, while the B.E.A. are actively collecting old documents of historical interest to the supply industry. For the aged cooker—even too aged, that is, to be let out on hire—there is no resting-place but the scrap heap. Yet the obsolete domestic appliance is of equal importance with the early machine in the history of the industry's growth, and just as much a part of our cultural background as the cooking-pot of Tudor times. In wishing E.D.A. success in their quest for specimens, we would also suggest that a valuable extension to their museum would be a Chamber of Horrors, which could hold all those items which, even in the light of their contemporaries, were of thoroughly bad design.

SHORT CIRCUIT CALCULATOR

MORE than once in these notes we have emphasised the serious consequences which may ensue from low voltage short circuits and the difficulty which frequently occurs in the evaluation of fault currents. Some years ago, Messrs. Trencham and Mortlock devised a simplified system of dealing with this problem. Although this is of outstanding interest to industrial maintenance and supply engineers, it is still not as well known as it deserves to be and on page 327 we publish an article giving the salient features of the method adopted. A further simplification has recently been devised in the form of a circular slide-rule which is applicable to the common run of problems, and eliminates all necessity for calculation. We consider this of sufficient importance to all concerned with low voltage systems to justify reproduction of this calculator as a reader service, and it will be found, in handy form for cutting out and assembly, adjoining the article in question.

EMERGENCY PUSH-BUTTONS

A POINT of particular interest raised in the new Code of Practice on installation and maintenance of electrical machines (reviewed by "Megohm" last week) concerns emergency stop switches. It is recommended that where danger may occur, due to restarting without the consent of the person who stopped the motor, stop switches should be non-resetting. This, of course, will involve slight modification to conventional motor control gear, since remote control stations normally consist of a pair of push buttons. It should not be a difficult matter, however, to arrange for the stop button to be held in by an additional catch, or to replace the push-button by a toggle switch mechanism. The increased safety obtained, particularly in the case of control stations located out of sight of the main control position, would amply justify the slight additional expense.

Meteor

Network Analysis

Blackburn Analyser Utilises A Voltage Analogue Method for Power System Studies

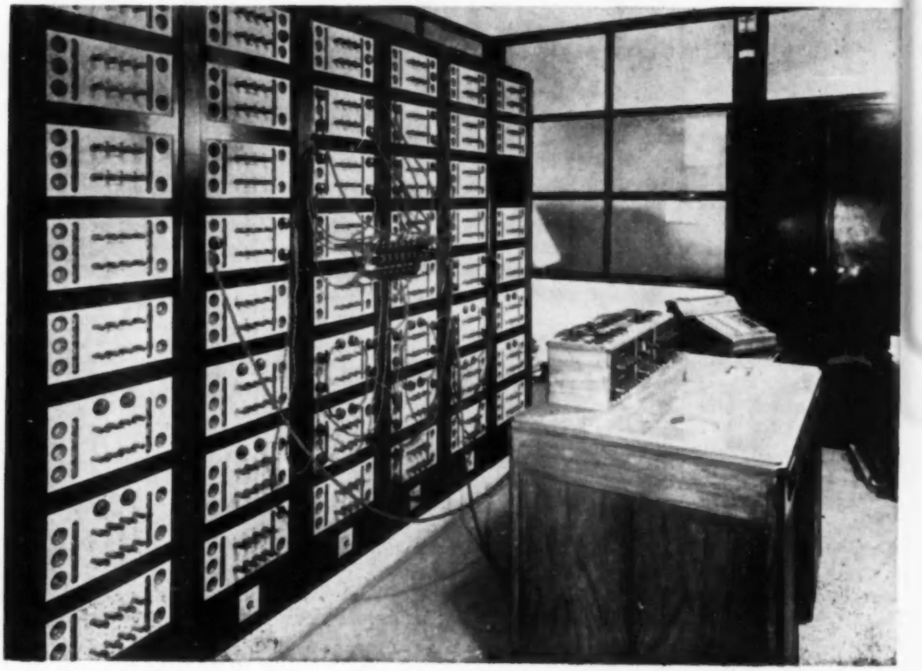
PRESENT-DAY electrical power systems have in the main grown from the integration of a series of small systems usually with one or two power stations situated near their centres of load.

This integration not only made the problem of determining load and fault current and system voltage levels much more difficult than it had been with simpler systems, but it also introduced additional problems, such as system stability. In general, the system network complexity became such that analysis by calculation, although theoretically possible, became a task of such magnitude as to be practically impossible in view of the time involved.

Accordingly, attention was paid to the development of calculating boards, in which the characteristics of lines, generators, transformers and loads could be simulated on a small scale by the introduction of actual impedances, generators and loads. To do this within a reasonable space, on the one hand, and to keep the effects of capacitance within bounds, on the other, it was found that an operating frequency for such calculators of about 500 c/s was most advantageous. A good example of this type of calculator is the A.E.I. machine installed at Willesden and described briefly in our issue of November 6, 1947.

The present article describes a calculator

General view of the analyser, connected to simulate a transmission line with distributed impedance



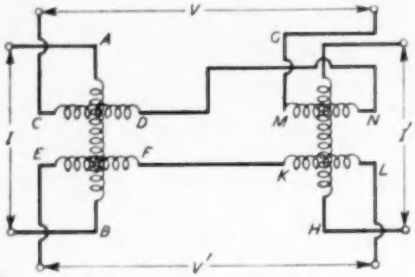


Fig. 1. Basic analyser unit circuit diagram

which utilises different principles to those used in the calculator referred to earlier. It is known as the Blackburn Analyser and was developed by Mr. C. L. Blackburn, a partner in Messrs. Merz and McLellan, in whose office at Carliol House, Newcastle-upon-Tyne, it has been in use since 1937.

Basis of the Analogue

In order to comprehend the manner in which the analyser functions, it is primarily necessary to appreciate the analogy between a transformer and a resistance.

Consider an ideal transformer with no losses, and with a turns ratio of T_1/T_2 where the suffix "1" refers to the primary winding, then the relationship between the primary and secondary voltages is given by $V_1 = \frac{T_1}{T_2} V_2$. Comparing this with Ohms law $E = RI$, we can see that by making $\frac{T_1}{T_2}$ equivalent to R, the secondary voltage V_2 will be equal in magnitude to I. Thus an idealised transformer can be analogous to a resistance.

It is, however, necessary to deal with complex quantities in a.c. network calculations. If we assume an impedance $R+jX$ with a voltage represented by $V+jV'$ impressed across it, the current which flows can be obtained from the equation

$$V+jV' = (R+jX)(I+jI')$$

where jV' and jI' are quadrature components of voltage and current respectively. By equating real and imaginary quantities the above equation reduces to

$$V = IR - I'X \text{ and } V' = IX + I'R.$$

It is on these two functions that the analyser operates.

Suppose we take a simple circuit as shown in Figure 1 which consists essentially of two transformers each carrying three windings (two windings, which are tapped, are shown horizontally for the sake of clarity). In the first transformer, let the ratio of the winding CD to the winding AB be "R" and the ratio of EF to the winding AB be "X," then a voltage equivalent to I provided across AB, will result in voltages equivalent to IR across CD and IX across EF. Considering the second transformer and setting the ratios of windings MN and KL to the winding GH as "X" and "R" respectively we get, for a voltage equivalent to I' across GH, voltages equivalent to I'X and I'R across MN and KL respectively. By connecting CD and MN in series subtractively, we obtain IR—I'X or V and by connecting EF and KL in series additively we get $IX+I'R$ or V'.

The converse also holds good, the application of V and V' across the appropriate points C and M and E and L respectively leading to the appearance across AB and GH of I and I'.

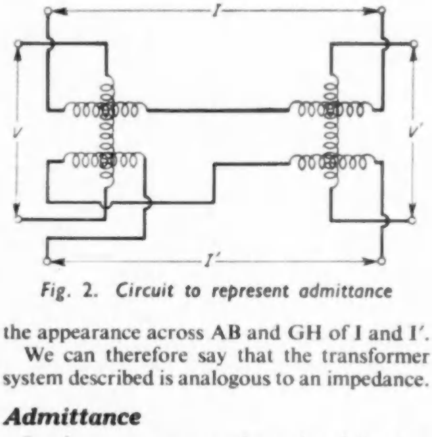


Fig. 2. Circuit to represent admittance

We can therefore say that the transformer system described is analogous to an impedance.

Admittance

In almost every case, the ratio of line impedance to load impedance or generator impedance in a power network is greater than the total range of impedance (1-1,000) available

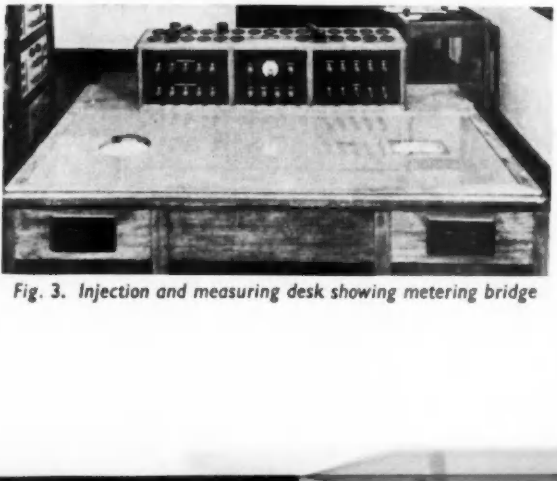


Fig. 3. Injection and measuring desk showing metering bridge

on the analyser. It would thus be impossible to represent most of the networks met in practice. The difficulty can be overcome by using admittances instead of impedances to represent loads. It is possible to derive a suitable analogue to represent admittance. Assuming the fundamental equation $V+jV'=(R+jX)\ (I+jI')$ which can be rewritten as

$$\frac{V+jV'}{R+jX}=I+jI'$$

By multiplying top and bottom of the left hand side of the above by $(R-jX)$ we obtain

$$\frac{(V+jV')\,(R-jX)}{R^2+X^2}=I+jI'$$

or

$$(V+jV')\left\{\left(\frac{R}{R^2+X^2)}\right)-j\left(\frac{X}{R^2+X^2}\right)\right\}=I+jI'$$

$$\text{or } (V+jV')\,(G-jB)=I+jI'$$

$$\text{whence } VG+V'B=I$$

$$\text{and } -VB+V'G=I'$$

The similarity of these equations to those used in the direct impedance case is obvious, and once again a similar type of circuit (shown in Fig. 2) can be used.

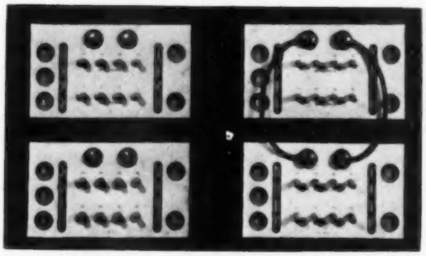


Fig. 5. Connections to introduce transformer ratios

Comparing Figs. 1 and 2, it will be seen that the only differences lie in transferring the reverse-connected coil from one transformer to the other and in substituting I and I′ for V and V′ at the input and output of the panels. By taking the terminations of the transformer windings therefore to suitable terminal sockets, with appropriate changeover plugs, there is no difficulty in converting the standard impedance panel to an admittance panel.

Iron Losses

At this juncture it might be as well to deal with a point of practical importance. All the foregoing has been based on the hypothesis of an ideal transformer; and the assumption has been made that all input and output voltages are in phase and directly related by the turns ratios involved. In practice, with the simple circuits shown, this would certainly not be so, as magnetising current would be drawn from the exciting voltage circuits. If, however, this magnetising current could be supplied from some external source and the transformer flux kept low enough to be sensibly proportional to the voltage, the original assumptions would still hold good.

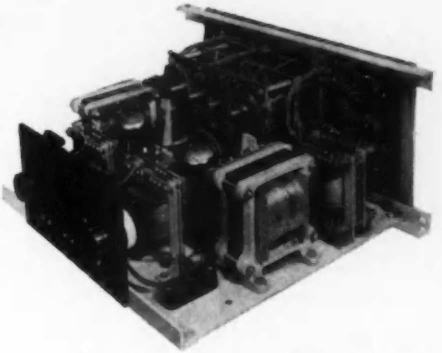


Fig. 4. Interior construction of unit

The requirement, therefore, is to provide a current from some external source 90° out of phase with the applied voltage and proportional to that voltage which will provide the necessary magnetisation. This is provided by an electronic feed-back compensating circuit which is connected to a fourth winding provided on each transformer. This winding measures as a voltage the flux in the core and supplies a proportionate amount of current for magnetising it. By this means the magnetising current is provided from an external source and not from the voltage analogues.

Impedances in Series and Parallel

It has been seen from the foregoing that a panel consisting of two multiwound transformers can represent an impedance. The

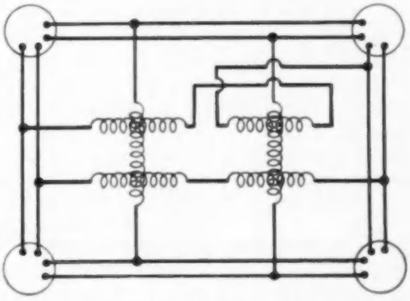


Fig. 6. Internal connections to sockets (schematic)

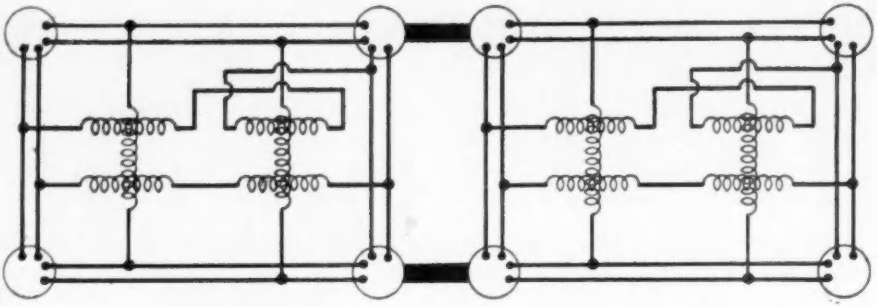


Fig. 7. Diagram to show method of connection to represent impedances in series

problem now arises of connecting such panels to represent impedances in series or parallel.

As the whole analogue is based on voltage equivalents simple plug-in connectors can be used, the contact resistance problem being virtually negligible.

The coil terminations are brought out to eight busbars which in turn terminate in four sockets located at the corners of each panel. A reference to Fig. 6 shows the schematic method of connection.

By comparing this with Fig. 1 or 2, it can be seen that all the voltages comprising V, V′, I and I′ can be transferred from these sockets. In practice eight-way plugs and sockets are used as this is the maximum number of ways that need to be provided in any one plug.

At this juncture it is conveneint to introduce some polarity considerations. We use the convention that the top and left sides of a panel are positive. The voltages to be transferred are therefore eight in number, and will be conventionally notated as V′+, V—, V′+, V′—, I+, I—, I′+, I′—. With this notation the top right hand socket carries I+, I′+, V—, V′—, and the bottom right hand carries I—, I′—, V—, V′—. If these are therefore connected to the left hand sockets of the next panel as shown in Fig. 7, the current voltages are transferred to the equivalent current busbars in the second panel and remain therefore unchanged. The V — functions, however, come on to the V+ busbars of the second panel. This is, of course, identical with two impedances in series where the current remains constant and the output voltage of the first, with reference to any arbitrary datum, becomes the input voltage of the second. Thus impedances in series can be represented by direct connections horizontally between the units.

The same reasoning applies to impedances in parallel. In this case the units are connected vertically as shown in Fig. 8 and V+, V′+, V—, V′— are transferred unaltered whilst the I—, I′— busbars of the panel are connected to the I+, I′+ busbars of the other. Thus impedances in parallel are catered for.

One further point arises. Some networks cannot be set up on the calculator using panels of the type already described, as they always lead to a short circuiting of the "current" busbars. To overcome this difficulty a panel having two "current" coils per transformer is used at the point in the network where the

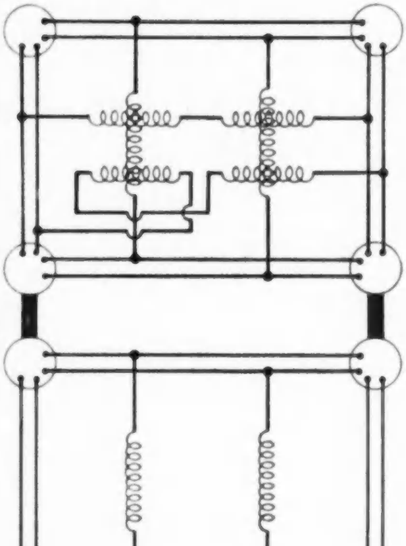


Fig. 8. Representation of impedances in parallel

short-circuiting occurs. The connections of such a panel are shown in Fig. 9, where it may be seen that by breaking the busbars at points X and Y the short circuit is removed. These panels are known as "Crossover" panels.

Loads, Generators and Transformers

A load is represented by an admittance as referred to previously, and a generator (a negative load) by inverting the connections of the "current" coils to the "current" busbars when it functions as a "negative" impedance or more usually a "negative" admittance.

Three panels are required for the simulation of a transformer. The first is set to give the transformer impedance characteristics and the other two panels are connected in such a way that they relate the primary and secondary voltages through the turns ratio of the transformer to be simulated and the primary and secondary currents through the inverse of that ratio. Thus all the transformer parameters may be introduced.

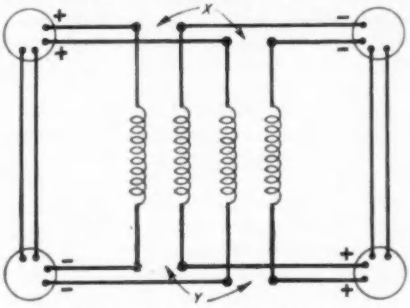


Fig. 9. Connections for a "cross-over" unit

Voltage Source and Measurement

As all the working voltages are in phase on the calculator, it is not necessary to have any elaborate equipment to supply the instrument and further, since most problems can be tackled by energising the calculator at a single point only, the above equipment is further simplified. It consists virtually of two tapped transformers with appropriate changeover switches to select the V and V′ busbars or the I and I′ busbars at the point in the network being studied.

In networks which require energising at more than one point, such as would be necessary in a multi-machine transient stability study, the appropriate voltages are obtained by energising the current windings in a number of panels corresponding to the number of points to be energised and obtaining the voltages required from the voltage windings of these panels. By this means, voltages having any magnitude or phase relationship to a given reference may be obtained.

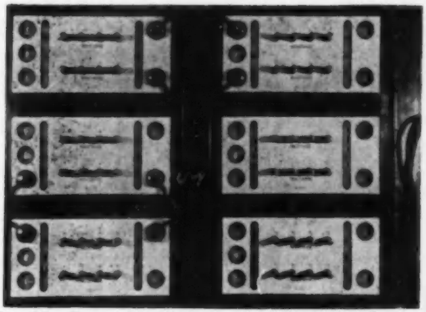


Fig. 10. Examples of external connections of units in series (above) and parallel (bottom left)

It is essential that the measuring system should not absorb any current from the network. It, therefore, consists of a bridge network using a valve voltmeter to indicate balance and a tapped transformer as the variable member of the bridge, the voltage analogues being read off directly.

Panel Construction

Each panel consists basically of two transformers each carrying four windings (except the cross-over panels which contain five) of which two are tapped. Each winding has a total of 1,000 turns. The tappings on the "R" windings of the two transformers are selected by ganged rotary switches so that the ratios of these windings can be set from 1 to 999. The same applies to the "X" windings. There is also a rotary selector switch associated with each of the above groups of switches for reversing the polarity as explained previously. The remaining equipment, shown in the photograph (fig. 4) is used in connection with the magnetising current compensation circuit.

A metering desk is associated with the calculator and contains the transformers for energising it and the bridge network for measuring purposes, both of which have been referred to previously. This desk is connected to the analyser, when it is in use, by suitable cords.

The analyser is used generally on load flow and short sircuit problems. It has been used on power system stability and on structural problems. In fact, it can be used on any problem where there is a linear relationship between the quantities involved.

Our thanks are due to Messrs. Merz and McLellan for permission to examine the analyser, and to Mr. J. G. Auld who collaborated in the production of this article.

Our readers' views . . .

"Personalities"

YOUR issue of the 9th February, 1950, extended over three pages, under the above heading, but in only two cases does the news relate to the supply side as distinct from other sections of the Industry. Considering the abnormal number of changes which have been taking place since Nationalisation, I should have imagined that you could have filled three pages in each issue with details of supply personnel alone.

This column is, I am sure, one of the most widely read in your paper, as it is of great interest to learn of the movements, promotions, etc., of former colleagues and fellow employees, and I am at a loss to know why there has been this gradual falling off of this type of information for the past several months.

Most of the Boards carry Public Relations officers, and I would like to suggest that information of this character, affecting each Board, should be automatically transmitted to the press for the information of the Industry, as appears to have happened in isolated instances.

Nomad

◆ ◆ ◆

Bearing Identification

YOUR correspondent, A. H. Harris, of Crayford, Kent, in common with many other users and maintenance departments, overlooks the fact, that it has for many years been the established practice of manufacturers to affix a name-plate to their products which bears a serial number.

A lot of embarrassment and time would be saved both to user and supplier if this number is quoted. Accompanied, if you like, with further details conveniently available, but in every case, in the name of manufacturers, please quote the serial number.

H. B. Rochester

SALE, LANCS.

◆ ◆ ◆

YOUR contributor has shown lack of foresight, in my opinion. It would have been an easy matter to obtain the required information from the makers of the motor by merely quoting the motor serial number, and better still, to have obtained spare bearings from the makers of the motor when installing the motor, by the same procedure. This method of course applies to other spares, not merely bearings.

A.B.

◆ ◆ ◆

Shift Workers' Qualifications

I HAVE read your editorial and the contributions of your readers on this subject with interest. There is no doubt that many shift workers, since the inception of the five-man rota, have continued studies to obtain some professional degree. To many the aim is to obtain Associate Membership of the I.E.E. It would not be the wish of any engineer to lower the high standard of this Institution, but there is a desire by the shift-worker to prepare for this examination without any obligation to either his employer or his colleagues. It is realised that 'the man up top' has a sense of responsibility towards his staff, but it must be that every hour not worked on shift by an engineer has to be performed by another to whom we must always be under an obligation.

The I.E.E. is an august body, but it is, first and foremost, an association of Electrical Engineers, and any engineer should be free to prepare for its tests in his own manner.

'Second Turn'

GLOUCESTER.

◆ ◆ ◆

I AM an ex-power station shift worker and I was requested by a young member of the staff to do his evening shift in order to allow him to attend evening classes for his National Certificate studies. Now I was not forced to assent to the change of shift, and others, I know, did refuse to change their shifts to allow people to attend classes, so that a shift worker's chances of attending evening classes depends upon the goodness and sportsmanship of one or two of his colleagues.

I agree with Mr. Parsons regarding correspondence courses, for one can shut oneself away and concentrate deeply on the problems presented. Points, therefore, are deeply impressed upon the mind.

Of course, there are different types of correspondence courses, and not all of them keep their promises in answering students' queries, especially if the queries are somewhat controversial or they happen to be the type for which a stock answer is not available. Of course, correspondence tuition cannot take the place of the laboratory experimental work. But is so much experimental work necessary?

My experience of laboratory work is that if any slight fault arises the experiment is abandoned. Invariably, there are too many students grouped around one experiment which is really being carried out by the instructor with about ten or a dozen students standing by as eye-witnesses. This, in my opinion, is not laboratory experimental work from the student's point of view.

I have known weak practical men produce beautifully written and illustrated laboratory note books, so the point in sending laboratory note books to the I.E.E. examiners is neither understood nor appreciated.

To sum up, I think the whole point of the I.E.E. ruling is to confine membership to those who can attend university courses and full technical college courses.

One consolation is that an employer will still employ an engineer who knows the job, and can do the job, who can organise others into carrying out the work. There are a good many with I.E.E. qualifications who are failures in this respect.

H. J. Raymond

DARLINGTON

◆ ◆ ◆

THE correspondence, under the above heading, which has been appearing in your columns for the past two or three weeks, deploring the non-recognition by the I.E.E. of correspondence courses, leaves me entirely unmoved. For a shift worker to say that it is impossible to attend evening classes with sufficient regularity to maintain the continuity necessary to follow the various sections of the syllabus is really absurd.

In addition to myself (I obtained the Higher National Certificate at a technical college on the outskirts of London) I am personally acquainted with several members of the electrical industry who have similarly attended evening classes and who are now associate members of the I.E.E., all of which have been shift workers throughout.

Of course, one has to miss occasionally, due to being unable to "swap a shift" or change a day off, but now that the industry has the five-man roster, things must be much easier than when we were all working the three-shift roster. If changeover cannot be arranged because others are also attending, then surely any who may be in the same year of the course and at the same school or college as the man in question, notes can be exchanged or loaned and questions for homework passed on. This point, by the way, raises another aspect which comes to my mind. One of your correspondents, J. T. Parsons, infers that correspondence courses are to be preferred to evening school courses, and further: "The grit and determination (excellent character-forming incidentals) necessary to complete a correspondence course, are worthy too of strong admiration." Now it is obvious that the finest type of correspondence course available cannot offer anything to compete with the comradeship of 30 or 40 men of various ages and jobs (important point this) listening to a lecture by a highly qualified member of the profession who, at the end of the lecture will (and does) answer any queries and assist in solving any problem.

No, the "grit and determination" are required to start a minimum of five years' attendance at evening school and to *complete* them, but the reward is in the comradeship so attained, and, of course, in the final success.

S. C. Patrick

HARROW, MIDDX.

◆ ◆ ◆

"English Repaired"

THE note under the heading "English Repaired to Order," in your editorial of February 9, seems an unjustifiably harsh criticism of the quality of the English used in technical papers published in this language in Scandinavia; the example quoted, moreover, could scarcely ever arise in a translation into English from any of the Scandinavian languages, and seems, in fact, to be a typical specimen of mistranslation from French.

Most scientific journals of the Scandinavian countries publishing articles in the more widely known Western European languages do, in fact, already set a very high standard of both technical and grammatical accuracy, and to cite only two examples, I would mention the "Acta Polytechnica" of the Royal Swedish Academy of Engineering Sciences and the "Transactions of the Danish Academy of Technical Sciences," Copenhagen.

G. N. J. Beck,

LONDON, N.W.6. B.Sc., A.M.I.E.E.

(We fear that our correspondent has taken "Meteor's" light-hearted comment a little too seriously. No such criticism was intended, and we agree that English translations published in Scandinavia are of a uniformly high quality—Ed.)

New Steam Cycle

Great Improvement in Efficiency Claimed

MOST regenerative gas turbine thermodynamic cycles are more efficient than the Rankine steam cycle at the upper temperature range and less efficient at the lower temperature range. Now that the steam cycle has reached 1,000° F for operational purposes, a given increase in temperature has much less effect on the steam turbine than the gas turbine. These considerations, together with the advantages of steam as a working fluid, have led **MR. J. F. FIELD, B.SC., M.I.E.E., M.I.Mech.E.** (Controller, S.E. Scotland Division) to propose the use of a gas turbine cycle using steam. Details of his suggestions are contained in a paper entitled "The Application of Gas-Turbine Technique to Steam Power," read before a joint meeting of the Institutions of Electrical and Mechanical Engineers on Friday.

Unlike the steam turbine, the gas turbine continues to show substantial theoretical and practical improvement up to a temperature of at least 2,000° F, while efficiency is independent of pressure. However, the elementary gas turbine, consisting of air compressor, pressure combustion chamber, turbine and regenerator, has the disadvantage, compared with Rankine cycle plant, of very large negative work and, in the absence of intercooling, of heat rejection at about 400° F. Moreover, expensive distillate fuels are in general necessary to operate the i.c. gas turbine.

Superheated steam can be used in a gas turbine if an externally fired superheater is provided in place of the internal combustion chamber, and if a spray type desuperheater is added. The mechanism then consists of a compressor, a superheater, a turbine and a spray type desuperheater. A typical machine is shown in Fig. 2, and it will be noticed that some steam is bled off before desuperheating. The quantity of steam thus abstracted is balanced by the water injected via the desuperheater sprays.

For the plant illustrated, the theoretical external heat input is calculated at 447·1 B.Th.U., for each pound weight of steam, and the mechanical heat available at the shaft, after allowing 203·5 B.Th.U. for the compressor, 214·0 B.Th.U. This gives a theoretical engine efficiency of 47·9% and a net plant efficiency based on electrical energy "sent out" of 40·85%; this assumes a 3,000 r.p.m. hydrogen-cooled generator, and vacuum of 29 in. Coal consumption at 11,000 B.Th.U./lb would be 0·76 lb/kWh sent out. Such a set, operating at a 75% load factor, would save about 73,000 tons of coal/year compared with present practice, which would involve a saving of some £200,000/year. If temperatures of 1,600° F, now only possible in short-life aircraft gas-turbines, become possible, the lb/kWh sent out would drop to 0·644.

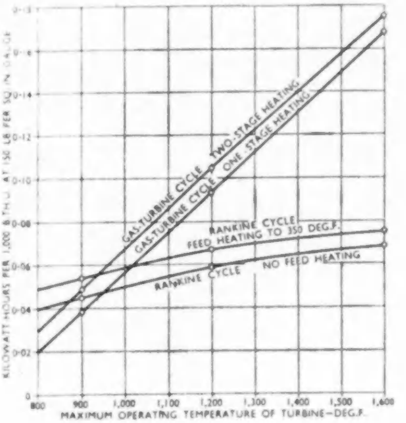


Fig. 1. Calculated plant efficiencies of combined electric generation and process steam plant

Heat Electric Generation

Combined process-steam and electric power generation is becoming of increasing industrial importance, and the paper compares a modern Rankine cycle plant recently erected in the U.S.A. with the possible condensing gas turbine equivalent. For such plant it is necessary to obtain the maximum heat drop above the process temperature, and in the U.S.A. installation a boiler plant giving 300 klb/hr of steam at throttle conditions of 1,450 lb/sq in. gauge, 900° F is used, with process steam at 150 lb/sq in gauge. The net generator output, after allowing for auxiliaries, is about 14·2 MW with 220° F feed water to the economiser. Additional feed heating arrangements increase output to 17·2 MW.

Still using the Rankine cycle, improvement in output would come by raising the operating temperature to 1,200° F and the output to 21·1 MW, but the superheater pressure would have to be increased to 2,400 lb/sq in. gauge, and operation would be difficult, especially starting up and shutting down. Change to gas turbine technique would permit the utilisation of 1,200° F steam at 600 lb/sq in. gauge, and the necessary mechanism is simple enough to be built in small sizes unlike that for the 1,200° F 2,400 lb/sq in. plant, which could only be justified for a fairly large installation. If reheating were adopted for this gas turbine cycle, working pressure would increase to about 1,000 lb/sq in. gauge, and the net output 33·2 MW with the same amount of process steam-heat as in the plant as now built.

District Heating

Electrical power made available in process heating plants is generated at 4,000 B.Th.U./kWh, as against 15,000 B.Th.U./kWh for the Grid; the most recent plant now being added to the Grid has a test heat rate of 10,700 B.Th.U./kWh sent out. In medium-sized towns interconnection with the Grid of condensing gas turbine type plant, combined with steam distribution to supply industrial needs, seems possible. The overhead charges on the heating mains and losses should be completely overwhelmed by the savings on generation. Similarly, for purely domestic and commercial district heating schemes, the gas turbine cycle for a small district heating plant of some 5 MW capacity can so increase the ratio of electric power to heat as to make even small, low density schemes attractive. Advantages over electrification for condensing gas turbine locomotive propulsion are also claimed.

Cost/kilowatt for process plant should be substantially less than for existing types.

Bases of Computation

In arriving at his conclusions, Mr. Fields states that he depends on the following bases:—

(*a*) Properties of steam.

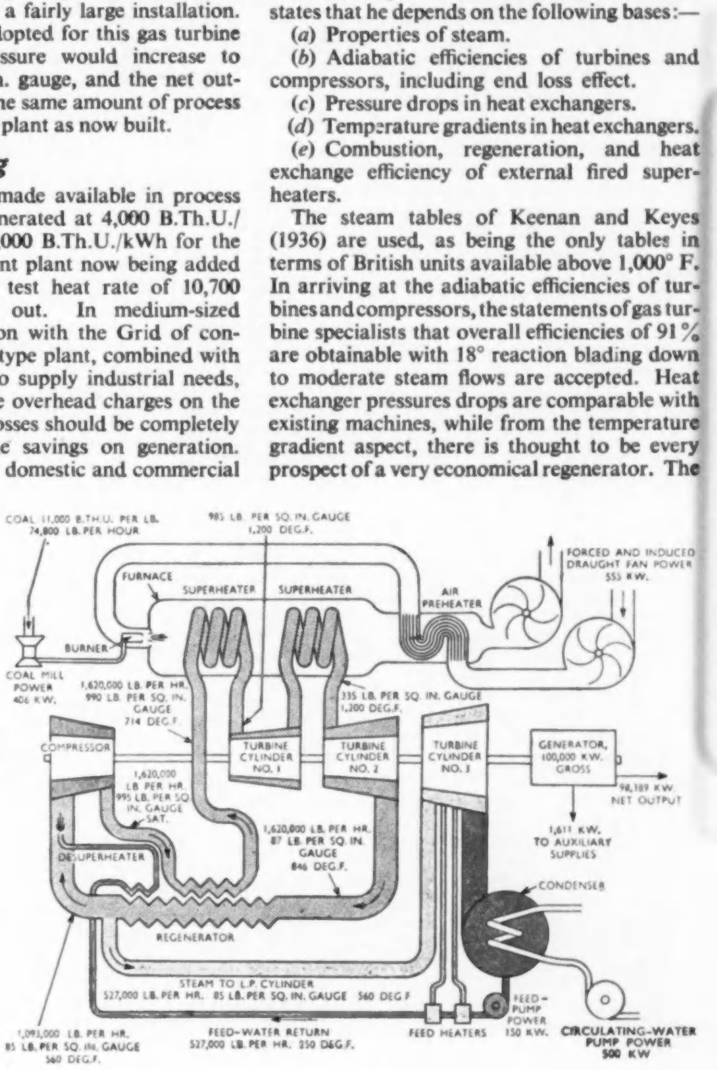
(*b*) Adiabatic efficiencies of turbines and compressors, including end loss effect.

(*c*) Pressure drops in heat exchangers.

(*d*) Temperature gradients in heat exchangers.

(*e*) Combustion, regeneration, and heat exchange efficiency of external fired superheaters.

The steam tables of Keenan and Keyes (1936) are used, as being the only tables in terms of British units available above 1,000° F. In arriving at the adiabatic efficiencies of turbines and compressors, the statements of gas turbine specialists that overall efficiencies of 91 % are obtainable with 18° reaction blading down to moderate steam flows are accepted. Heat exchanger pressures drops are comparable with existing machines, while from the temperature gradient aspect, there is thought to be every prospect of a very economical regenerator. The



COAL 11,000 B.TH.U. PER LB. 74,800 LB. PER HOUR
985 LB. PER SQ. IN. GAUGE 1,200 DEG.F.
FORCED AND INDUCED DRAUGHT FAN POWER 555 KW.
FURNACE
SUPERHEATER
SUPERHEATER
AIR PREHEATER
BURNER
COAL MILL POWER 406 KW.
1,620,000 LB. PER HR. 990 LB. PER SQ. IN. GAUGE 714 DEG.F.
335 LB. PER SQ. IN. GAUGE 1,200 DEG.F.
COMPRESSOR
TURBINE CYLINDER NO. 1
TURBINE CYLINDER NO. 2
TURBINE CYLINDER NO. 3
GENERATOR, 100,000 KW. GROSS
98,389 KW. NET OUTPUT
1,620,000 LB PER HR. 995 LB. PER SQ. IN. GAUGE SAT.
1,620,000 LB. PER HR. 87 LB. PER SQ. IN. GAUGE 846 DEG.F.
1,611 KW. TO AUXILIARY SUPPLIES
DESUPERHEATER
CONDENSER
REGENERATOR
STEAM TO L.P. CYLINDER 527,000 LB. PER HR. 85 LB. PER SQ. IN. GAUGE 560 DEG.F
FEED-PUMP POWER 150 KW.
1,093,000 LB. PER HR. 85 LB. PER SQ. IN. GAUGE 560 DEG.F.
FEED-WATER RETURN 527,000 LB. PER HR. 250 DEG.F.
FEED HEATERS
CIRCULATING-WATER PUMP POWER 500 KW

Fig. 2. Flow diagram for 100 MW coal fired condensing gas turbine

extension of regenerative steam heating to 750° F necessary for gas turbine technique at 1,200° F requires only a moderate development of existing air-preheater technique to maintain "boiler" efficiency.

Wet Compression

It is possible to avoid wet compression by injecting only sufficient water to bring the air to a dry saturated condition, the rest being injected stage by stage in the compressor. However, for simplicity the whole quantity should be injected ahead of the compressor in the form of a fine mist. This forms an "emulsion" with the steam and should not affect the efficiency of the compressor blading.

DISCUSSION

Mr. C. L. Blackburn (Merz and McLellan), who opened the discussion, said that the nearest comparable cycle to that suggested by the author was the closed-circuit gas-turbine cycle using air, which was at present being developed in Scotland, and with which at 1,250° F on a 12 MW set they would expect an overall efficiency of 31·9%. This was a good deal less than the author's figure of 42%, assuming an efficiency of 75% for the author's steam heater the figure of 42% should be reduced to 36%, while an allowance for station auxiliaries would reduce it still further. Even so, it would be higher than 31·9%, and this was due, not to the better properties of steam as compared with air as a working medium, but to the way the author recovered the heat of compression.

In spite of gas turbine developments, condensing steam cycles were still of great practical importance for power generation. Using a pressure of 1,500 lb/sq in. and 1,050° F initial temperature and reheat, a 90 MW installation was running at Boston, Mass., giving 39% on a units generated basis, compared with the author's 32%, assuming an efficiency of 75% for his steam heater.

Mr. W. N. C. Clinch thought that the author seemed to confuse the thermal efficiency of a turbine with the utilisation of the heat which was required for other purposes.

Mr. S. B. Donkin (Kennedy and Donkin) said that the combination of the high efficiency of the gas turbine over the upper temperature range and the more efficient steam turbine over the lower temperature range was ideal in principle; the question was whether it could be attained in practice.

An important feature of the author's cycle was the higher ratio of energy output to process steam. If it were possible to produce more electrical energy for the same output of heat it should be easier to secure the adoption of heating schemes.

The possible saving in fuel was so great that it seemed essential for research to be carried out, beginning with the wet compressor.

Mr. J. W. H. Dore (B.E.A.) agreed that theoretically the author's cycle showed very appreciable gains, but said that cycles of the author's type, however, as of gas turbines, were extremely sensitive to component efficiencies and pressure drops, and it would not take very large reductions in the component efficiencies and pressure drops assumed by the author to lower the overall efficiency of the cycle to a point where it ceased to be so attractive. Moreover, such a cycle inevitably involved a greater installed capacity of plant for the same output than the Rankine cycle.

Mr. H. L. Ritz (C. A. Parsons) said that from the temperature entropy diagram it would be seen that the author's statement regarding the thermodynamic superiority of his process compared with the steam turbine was justified, and that for the production of process steam his cycle provided a higher power output per unit of process steam than did the Rankine cycle. The effective temperature range within which the gas turbine cycle and the Field cycle operated was greater in the case of the latter, but it did not follow that this would lead to its greater efficiency. The greater complication of the Field cycle compared with the closed gas-turbine cycle was not counterbalanced by a corresponding gain in efficiency.

Mr. C. W. Marshall (B.E.A.) said that further information was required on the economics of the regenerator, and doubts had been expressed about the compressor. He would view with the greatest suspicion any compressor-cum-desuperheater until it had been tested in practice.

Mr. B. E. G. Forsling (B.T.H.) said that the key to the author's cycle was the wet compression and how near to ideal conditions it could be carried out. In addition to the normal compressor losses, for which the author allowed, there would be losses in the injection of water. He could not agree with the author in regarding wet compression as a reversal of the normal process of adiabatic expansion because there was a fundamental difference between wet expansion and wet compression.

Mr. R. G. Voysey maintained that the author damaged his case by basing his cycle calculations on the highest component efficiencies ever published for gas turbines. Two basic advantages of the gas-turbine cycle lay in its low expansion ratio, allowing optimum design of turbine blading at both ends of the expansion, and its avoidance of the external-fired boiler. To improve steam turbine efficiencies it would be better to use one h.p. turbine to replace several existing h.p. turbines and so allow better blade proportions and efficiency.

Mr. I. V. Robinson said that the author's figure for casing efficiency of 87% was suspect, and the figure of 91% for the efficiency of the turbine casing was very high.

Mr. F. F. Ross said that workers at B.C.U.R.A. agreed with the author that a coal-fired open-cycle gas turbine could not have a higher thermal efficiency than a modern Rankine cycle, but they had found a way of combining gas turbine and steam cycle so as to offer many advantages.

The Author replied briefly.

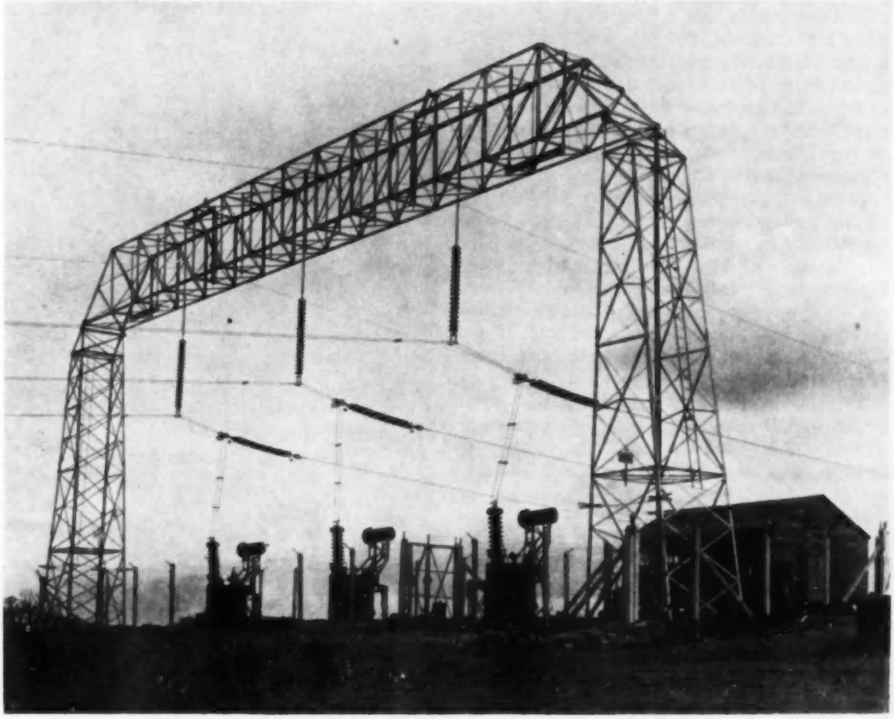
B.E.A. 275 kV Line

Most effective conductor design being sought

IT has long been realised that the Grid in its present form and operating under present conditions for transmitting large blocks of energy, will require considerable reinforcement if it is to carry successfully the estimated future load. It was accordingly decided by the B.E.A. that a "Super-Grid," operating at 275/300 kV should be constructed to reinforce the existing 132 kV system. Plans are therefore going ahead on the design of a system capable of meeting probable requirements for the next 20 years, and envisaging, on a long-term basis, the possible operation of certain sections at voltages as high as 380/400 kV. The "nominal voltage" of 275 kV has however been chosen for the first part of the project as it is an international standard, but it is anticipated that the maximum voltage on the system may, under certain load conditions, rise to a figure in the neighbourhood of 300 kV. It is hoped to commission certain sections of this "Super-Grid" within the next five years.

Line Design

Work is actively proceeding on the design and development of the type of line to be used; this is mainly being carried out at the B.E.A. research laboratories at Leatherhead. While high voltage systems of this nature have been in operation abroad for many years, and in consequence much basic information is available, conditions in this country are such that direct adoption of those techniques is not feasible. This is mainly due to the high incidence of atmospheric pollution in the industrial regions of Great Britain, which is so bad in many areas, that even on the 132 kV system insulator flashover can occur if the insulator strings are



A general view of the first gantry and transformers at Leatherhead not regularly washed and maintained. In consequence much work is required on the effect of atmospheric changes and the effects of pollution on the various types of insulator designed for 275 kV operation. Another point of considerable importance is the establishment of the most effective type of conductor for the reduction of corona loss. Many measures have been proposed to effect this, such as artificially increasing the effective diameter of the conductor or the use of two or more conductors per phase, in close proximity, to reduce the maximum field stress.

Experimental Line

The experimental line at Leatherhead consists of two 1,200 ft spans of conductor carried on three 120 ft wide gantries. The use of gantries instead of the more conventional tower is to enable measurements of loss, etc., to be carried out with various phase separations.

Two of the gantries are 93 ft high, and one, situated on a hill is 50 ft high. (These dimensions refer to the inside of the gantries.) At present, tests are being made using twin conductors of 0·77 in. diameter (37/0·11 steel-cored aluminium) spaced 12 in. apart on each of the three phases in a horizontal plane at a phase separation of 32 ft 6 in. Two earth wires, symmetrically disposed, are strung in a horizontal plane, 20 ft above that of the conductors and at a separation of 49 ft. The line is energised at 275 kV between phases, and has been in operation under these conditions since November 30, 1949.

In addition to the facilities for altering the phase spacing, arrangements have been made for adjustment of the space between the twin conductors from 4 to 12 in. in steps of one inch. When sufficient data have been obtained from the 12-in. spacing, work will begin on investigating the operating conditions at 6 in. Tests will also be carried out using single conductors of approximately 1¼ in. diameter.

The line insulation consists of cap-and-pin insulators, 19 units being used at suspension and 17 units at tension positions. Stabilised rod-type insulators will be used at a later date.

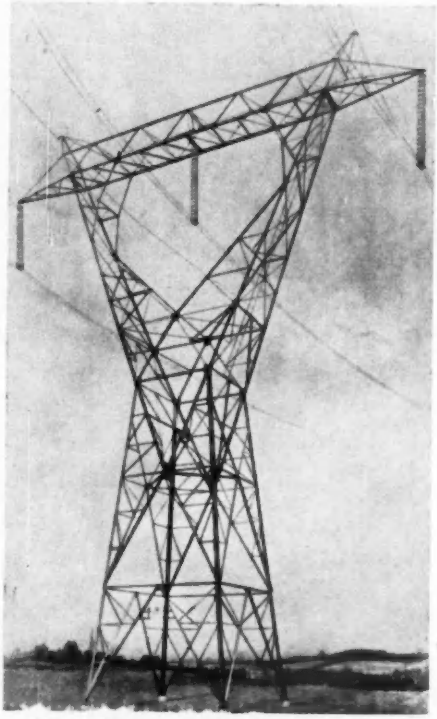
Transformers

Three single-phase transformers are used to energise the line. These have a total continuous rating of 300 kVA. The secondaries are star-connected and are equipped with an insulated winding for cascade connection, which will be employed when tests at 400 kV are undertaken. The primaries are delta-connected and are fed from a 400 volt three-phase supply from Leatherhead grid substation. Tappings are provided to give a range of outputs of 236-290 kV.

Measurements

The measurements to be made are mainly directed to that of measuring corona loss and power loss, and accordingly a recording wattmeter is connected in the primary of the transformer feeding the centre phase. It is proposed to make check measurements on all three phases, but for design use on an actual transmission system using transposed conductors the figures obtained on the centre phase will be the most useful and readily applicable. Continuous records are also being made of primary current, primary voltage, and neutral current in the secondary between star point and earth. Measurements are also being made of the leakage current on the insulator strings; and the line behaviour in wind is checked by vibration recorders fitted to the central span conductor.

As the purpose of the test set up is to obtain a correllation between line losses and weather conditions, a small meteorological station has been established in the transformer enclosure.



Proposed design of 275 kV standard tower

The Economics of SAFETY

Report on earthing practice supports multiple earthed neutral

EARTHING on electrical supply systems is from one aspect a means of buying safety, and this viewpoint is markedly developed by MR. L. GOSLAND, B.SC., M.I.E.E., in his paper on "The Cost and Efficiency of Earthing on Low and Medium Voltage Overhead Line Systems." Reading this before a joint meeting of the I.E.E. Supply and Utilisation Sections in London last week, the Author stressed that only danger of electric shock is considered, the danger of fire risk not being taken into account.

A review of available methods of earthing opens the paper, the traditional expedient of direct earthing of the system neutral and the protected installation being taken first. The efficiency of this method depends on a fuse blowing when an earth fault occurs, and thus the efficiency of protection against excess voltage depends on the duration of that voltage. The resistance of both substation and installation earth electrodes is involved, but if the product of the consumer's earth resistance and the 1 minute fusing current of his largest fuse is less than 40 V, then there is absolute protection against prolonged electrification of earthed metalwork at a dangerous voltage.

Where soil resistance is high, recourse may be had to a separate earth wire run throughout the whole system and earthed at a single point. While the wire is continuous there is no danger of a prolonged fault, if the intentional earth resistance is kept lower than that possible from an accidental earth; but much danger lies in the chance of a broken earth wire, in which case any fault on the remote side of the break may make all other installations connected to this part of the wire dangerous. If the earth wire is multiple earthed, the chance of this condition arising is greatly reduced.

Various systems are available which depend on the connection of the neutral to earth, and of metalwork, etc., to the neutral. The first of these is similar to the method described above, with the neutral earthed only at one point; the danger is that a broken neutral raises all installations beyond the break to phase voltage, even in the absence of any other fault. Earthing the neutral at each end of the line, and at intervals along it (multiple earth neutral) can reduce this risk, and on the continent a similar system is widely used, being known as "Nullung." Operating with more stringent regulations, it is known in Great Britain as "protective multiple earthing," and the neutral is connected to earth at the supply transformer (electrode earth resistance not > 4Ω), at the end of each distributing main (not > 10Ω), at the supply terminals of each consumer (electrode form specified) and at such intermediate points as will reduce the overall resistance from the neutral to earth to below two ohms.

TABLE I. COST OF PROVIDING EARTHING FOR 100 CONSUMERS ON A 2-MILE LINE

Type of Earthing	Soil 20 × 10³ ohm-cm		Soil 100 × 10³ ohm-cm	
	2 ohm earth	8 ohm earth	2 ohm earth	8 ohm earth
	£	£	£	£
Direct earthing	7,500	2,000	—	8,200
Separate earth wire				
—multiple earthed ...	470	420	720	480
—earthed at consumers	560	560	800	560
P.M.E.				
—earthed on line ...	60	10	305	75
—earthed at consumers	150	150	345	150
E.L.C.B.	560	560	560	560

Voltage operated earth leakage circuit-breakers offer direct protection against excess voltage on exposed metalwork, provided the common earth continuity conductor to which this is connected is unbroken. Current balance earth leakage circuit breakers, however, are not discussed in the paper.

Shock Hazard

For the purposes of the argument developed in the paper some quantitative evaluation of shock hazard with the systems described is required. A broken earth wire gives rise to such danger in all cases, while a broken service earth wire can only directly affect the separate earth wire system. Similarly, high resistance of a normal earth electrode is only dangerous on the direct earthing system. Broken line neutral, in connection with a single phase or unbalanced load, affects installations beyond the break in all systems earthing to the neutral, and a broken service neutral has a similar result for an individual consumer. Risks, other than the neutral considerations, arise only if some appliance is faulty, and with respect to human life, this is one with a voltage on the metalwork of above 40. Some 90% of all faults are likely to have a winding-to-frame impedance less than 100Ω, while the impedances of the remaining 10% are evenly distributed up to $10^4\,\Omega$. With this basis, a calculation is made in the paper for fault-years/appliance/year. The probability of the various types of fault developing on various systems are then estimated symbolically, various more or less important assumptions being made in this closely argued section of the paper.

Earthing Costs

Estimation of the cost of circuit breakers, line materials and specially installed earthing electrodes is relatively simple, but some complication in comparing the expense involved in the various systems of earthing arises because the availability of a piped water supply probably allows the consumer to obtain an electrode resistance of about 10Ω without expense. However, estimates were arrived at, and values extracted from the curves included in the paper are shown in Table 1.

The risks to be associated with each type of earthing were calculated from the replies to an enquiry made of five undertakings (prior to vesting day), and the relevant figures are given in Table 2. In this connection it should be noted that the chance of an open circuited earth continuity conductor causing danger tends to swamp all other considerations, and as this is common to all methods of earthing it has been treated as an "internal" risk and allocated a constant value.

Combining the data contained in the two tables with the algebraic expressions for the estimates of risk with different systems of earthing, curves are obtainable relating risk in danger-years/year/consumer to the cost of earthing a 2-mile long line serving 100 consumers. Danger-years/year/consumer is, however, an unwieldy unit, and it has been replaced by the more positive concept of safety unit. This is estimated on a basis of the risk due to faulty appliances on systems with no earthing at all, which represents the maximum amount of safety that can be purchased by earthing. On this basis Figure 1 indicates the safety/expenditure curves for various systems, direct earthing giving less safety for the given range of expenditure considered.

If earthing which gives a total risk of the order of twice the internal risk (which is not affected by earthing) is acceptable, all systems are satisfactory, though direct earthing is economically impracticable. Separate earth wire schemes and the e.l.c.b. give a high standard of safety, not greatly affected by electrode expenditure, while p.m.e. is cheaper for low resistivity soils and about as costly for high resistivities. If a slightly higher risk is accepted, protective multiple earthing schemes show great economic advantages.

When a system other than direct earthing has been accepted, the choice of resistance level can to some extent be guided by cost. With a separate earth wire it is hardly worth while earthing at consumers' terminals, since the earth resistance is likely to be so high that there is little decrease in risk. The money is better spent on testing the earth continuity conductor. With p.m.e. a small increase in safety involves a considerably increased expenditure, and the low overall resistances specified in this country have previously made use in this country economically impracticable.

Conclusions

In regions of soil resistivity above 5,000 ohm/cm where no network of earthed conductors exist, direct earthing is more costly than any other system for a comparable standard of risk, and may be impracticable.

TABLE 2. ESTIMATES OF INDIVIDUAL RISKS

Data	Undertaking					Figure adopted
	1	2	3	4	5	
Faulty appliances/year/1,000 appliances	2·5	< 1	—	10-80	1·25	25*
Duration of fault, if no gear operates	0·8	—	—	—	—	0·5 day
E.L.C.B. faults/year/1,000 e.l.c.b.	50	—	—	—	112	50
Duration of e.l.c.b. faults	42	—	—	—	42	42 days
Breaks/year/conductor/1,000 miles line	30	8·2	0	10	1	42
Average duration of break in phase or neutral	1	0·5	—	0·2	Few hrs.	0·5 day
Average duration of break in earth wire	30	—	—	—	—	365 day
Broken service conductors/year/1,000 consumers ...	20	·007	—	—	·04	1
Average length of l.v. o.h. distribution system/transformer	1·1	0·3	—	0·7	0·6	2 miles
Average number of main radial branches/transformer ...	3	4	2·5	3	3	3
Consumers/mile of o.h. line	128	50	50	85	50	50

* *On basis of one appliance/consumer*

Separate earthwires and e.l.c.b.s give the highest standard of safety.

P.M.E. is only slightly less safe than other, more expensive methods, and the degree of safety is not highly dependent on expenditure on earth electrodes; for practical purposes an upper limit of 10Ω, irrespective of the number of consumers, is recommended as the overall earth resistance. About 600Ω/consumer is an economical level on three phase systems, and this is concordant with practice in Australia and New Zealand. For single phase lines 200Ω earth resistance/consumer should give an acceptable level of safety. The use of direct earthing, independent of the neutral, on any installation connected to a system using P.M.E. must be prohibited.

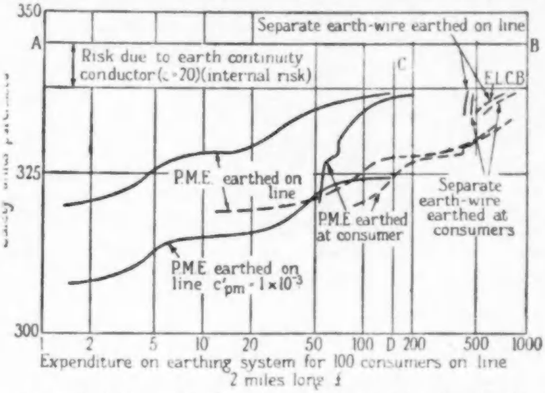


Fig. 1. Relative costs of earthing at acceptable safety levels

Full lines, 5,000 ohm-cm; broken lines 100,000 ohm-cm earth resistivities

DISCUSSION

Mr. E. Fawssett, in a contribution read to the meeting in his absence, pointed out that a considerable change in any one of the assumptions made in the paper had little effect on the relative worth of the author's method. Earth-leakage circuit breakers were probably the best theoretical protection, but experience with them had been very diverse. For village networks which were part underground and part overhead he favoured a continuous earth wire on the overhead line connected to the cable sheath and to the substation neutral. He was in favour of the authority providing the protection and accepting responsibility.

Mr. H. G. Frampton, referring to the one-minute fusing current basis adopted by the author, considered a fault persisting for one minute a serious risk, and with a hand-held appliance almost certainly a fatal risk. It was better to think in terms of seconds, or possibly a second. That meant a totally different picture in regard to direct earthing and electrodes. The author showed that to get low resistances by electrodes was very costly, so much so that it had very largely not been attempted.

Mr. H. G. Taylor (Welding Research Association) said that the subject of earthing had always bogged down on the question of cost, but now it seemed that a satisfactory measure of safety could be obtained at a reasonable cost.

Mr. F. H. Mann (Factory Dept., Home Office) suggested that the circuit-breaker operating on current balance, which was dismissed somewhat cursorily in the paper, afforded protection under critical conditions which would not be given by fuses or by the voltage-rise type of circuit-breaker.

Mr. A. H. F. Linton (M. of F. and P.) said that an examination of reportable fatal accidents during the last 14 years showed that $33\frac{1}{3}\%$ included the earthing factor. The majority of them were due to the use of an unearthed appliance in an earth fraught situation, and one of the fuse-operated earthing systems considered in the paper offered protection against this type of accident. He suggested that for domestic consumers in rural areas where earthing conditions were difficult an earth-leakage circuit-breaker offered the highest all-round standard of safety.

Earth electrodes should be installed a span away from transformer poles, where there were usually stays which could increase the risk from voltage gradients.

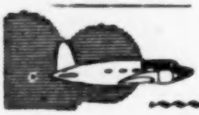
Mr. T. C. Gilbert criticised the paper for not dealing with fire risk; a growing proportion of fires was ascribed to electricity. He believed that a previous E.R.A. report stated that it was possible that with protective multiple earthing the fire risk was greater than with ordinary earthing. He also suggested that the e.l.c.b. had been debited with excessive costs in the analysis.

Mr. H. W. Grimmitt (M. of F. and P.) remarked that people were still installing what might be called token earth plates. He often wondered why the simple expedient was not adopted of testing installations by just blowing the fuses. In his opinion the Australian system of fixing earth leakage trips to earth electrodes was unnecessary. The second electrode decreased the sensitivity of of the trip.

Mr. A. E. Morgan mentioned an experience in North Wales, with a rocky subsoil, which showed the need for providing lightning protection on earth-leakage circuit-breakers.

Mr. P. B. Frost suggested that the very large number of assumptions made in the paper raised doubt as to the value of the conclusions. It should be borne in mind that if protective multiple earthing was used the whole responsibility for earthing, and its cost, was being thrown upon the supply authority.

The Author replied.



overseas news

Persia's 7 Year Plan

In the Seven Year Plan of Persia, it is proposed to increase the central power station generating capacity existing or already planned from 73,700 kW to 290,900 kW. Of the first total, the capacity of the Tehran plant accounts for 23,000 kW and that at Isfahan 18,500 kW. There is also available some 63,000 kW capacity at various industrial plants, mainly diesel generating sets. Public utilities draw upon this capacity to a considerable extent. Under the new proposals, the plant at Isfahan will be increased to 117,500 kW. It is proposed that the 34 principal cities, with populations of over 25,000, would each have central electric power stations, with additional plant in the minor cities. Of the new stations 55% will be steam and 45% diesel operated.

In the scheme it is also recommended that any hydro-electric possibilities should be investigated, and that certain 500 kW mobile rail diesel power units be purchased.

Brisbane Railway Electrification

Following the presentation of the further report on the electrification of the Brisbane suburban railway system, to which we referred in January 16, the Queensland Government has now approved the scheme, it was officially announced last week. Cost of the project is now estimated at £A8,853,000. It is understood that tenders for the rolling stock, power supply equipment and other materials will be called within the next six months, and it is hoped that the job of electrification will be completed in eight or nine years.

Water Heater Control

The State Electricity Commission of Victoria has prepared specifications and is calling for tenders for impulse equipment to provide central control of electric hot-water systems.

Canada's Plastic Industry

The importance of plastics in the development of Canadian industries was the theme of the address Mr. A. E. Byrne, executive of the Canadian General Electric Co., gave at the eighth annual convention of the Society of the Plastics Industry, held in Toronto last month. Subsequently it was stated that the outmoded tariffs affecting importation of plastics into Canada, which had been unrevised for ten years, were to come under the scrutiny of the Tariff Board in Ottawa on March 15. During those ten years, investment in the industry had grown from $5,000,000 to over $50,000,000, employees in 1949 numbering 15,600. "The rapid advance of the industry had brought it to the point where it needed a solid tariff foundation on which to proceed for future growth," an official declared. Mr. L. C. MacLeod, of Montreal, was re-elected president of the Society.

Duty on Motors

The Government of India has decided to extend the existing protective duty of 10% *ad valorem* on electric motors, which is due to expire on March 31 next, for a further three years. The Tariff Board had suggested that the duty be increased to 15% on all motors and parts up to 20 h.p., and a restriction on the import of motors up to 15 h.p., but the Government has rejected these proposals, although the position will be reviewed from time to time.

Dispute in Cawnpore

In the Allahabad High Court recently, the Cawnpore Electric Supply Corporation Ltd., sued the United Provinces Government and two former employees of the company in connection with the purchase of the company's undertaking by the U.P. Government, and claims of employees adjudicated under an award by a conciliator.

The company sought an injunction restraining the Government from enforcing or acting on the award of the conciliator. The latter had given an award recommending that the Corporation should distribute 50% of the reserve fund after meeting liabilities, if any, to employees and that the existing fund be continued, but that it be transferred to a provident fund of each employee when the Government acquired the undertaking.

The adjudicator also awarded a bonus, stating that the Government, when taking over the company, should consider it a liability against the firm. As a result approximately £502,500 of purchase money was frozen.

For the company it was stated that on March 17 last, the U.P. Government served notice of acquisition of the undertaking. From resultant discussions between the firm and the workers' union, the latter presented certain demands. The company maintained that no decision on the demands could be made until the amount to be paid by the Government for acquisition of the undertaking had been agreed. Subsequently the Government had promulgated the Industrial Dispute Ordinance, 1947, and appointed a conciliation officer to adjudicate certain issues arising out of the dispute. The plaintiffs maintained that there was no reserve fund from which to give employees 50% as a farewell bonus. The hearing is likely to last several days, we understand.

Expansion in Italy

Two recovery projects to add to Italy's power generating facilities have been approved by the Economic Cooperation Administration. The total cost of the two power schemes is the equivalent of $20,266,000, of which $12,253,000 will be supplied by ECA and the equivalent of $8,013,000 will be furnished in lire by Italian companies through normal financing channels. One project provides for the installation of an additional 60,000 kW of steam power generating capacity in the Maurizio Capuano plant, at Naples, of Societa Meridionale di Elettricita (SME). ECA financing amounts to $6,143,000 and lire requirements are the equivalent of £2,885,000. This is the second project for the expansion of this station, for in May, 1949, a 30,000 kW addition to the plant was approved. The SME group, which is now heavily dependent on water-power, produced about 90% of the total electricity sold in Southern Italy.

The second project involves installation of a 60,000 kW turbo-generator set and associated boiler equipment in a new plant to be built at Civitavecchia. The plant layout has been planned to permit ultimate expansion to a total capacity of 180,000 kW. It is expected that the first 60,000 kW unit will begin operating at the end of 1952. The total cost of the project is the equivalent of approximately $11,238,000, including $6,110,000 in ECA financing. This development is sponsored by Societa Romana di Elettricita in association with Societa Elettricita SELT-Valdarno and TERNI-Societa per l'Industria e l'Elettricita. The hydro-electric plants of the last-named concern constitute the largest generating system in central Italy.

Battery Development

A new battery acid which can be charged automatically and rapidly has been developed by Karl Kurt Gruening, of Hamburg, and marketed under the name S.B.A., it is reported. Discharged accumulators may be charged within twenty minutes simply by adding the acid, and without resort to a charging station, it is claimed. Moreover batteries charged with this acid are said to have a substantially higher capacity and longer life than those filled with the usual electrolyte, for S.B.A. avoids the formation of sulphate. Licences for the production of the acid in Austria have already been granted, and negotiations with British, Swiss, Benelux, French and U.S. interests are stated to be under way.

Another N.Z. Scheme

Land surveys are now under way in New Zealand in connection with a scheme for harnessing the waters of the rivers Wairau, Mangles and Buller, and lakes Rotoiti and Rotorua for the generation of hydro-electric power. Called the Mangles, or Braeburn scheme, it has a potential of 250,000 kW, and work will be pushed ahead as soon as possible. It will provide power for the northern portion of the South Island.

Under the scheme a tunnel will link the two lakes which lie more than 1,500 ft up in the mountains and the capacity of Lake Rotoiti will be increased with water tapped from the upper reaches of the Wairau river, which flows on a higher level several miles to the east. A generating station with an output of 60,000 kW will be established at the Rotorua end of the tunnel from Lake Rotoiti, the source of the Buller river. The next stages will be the turning of the water into the Mangles river to the west, to develop a further 120,000 kW. It is planned to establish a third generating station at Langford, on the Buller river.

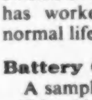
Water Leakage

Because of serious leakages from the power tunnel supplying water to the turbines, the Arnold River hydro-electric power station, South Island, N.Z., was shut down for some time last month. During the last ten years the leakage of water from the half-mile tunnel from the Kaimata dam to the Arnold power house has increased steadily, until a small stream was running back from the pipeline into the river. Upon an examination by engineers it was decided to start repairs immediately, entailing the laying of a new concrete bottom to the tunnel. Arnold power station houses two Boving Kaplan vertical water turbines each direct coupled to a 1,530 kW English Electric alternator.

Telephone for N.Z.

The New Zealand Government has completed a bulk supply agreement with British telephone manufacturers covering orders for the supply of telephone exchange equipment to the value of £3,500,000 in the next two years. Announcing this last week the Postmaster General, Mr. W. Broadfoot, said five manufacturers would participate.

New O.F.S. Power Plant



Tenders for its new power station scheme were accepted by the Dewetsdorp Town Council, Orange Free State, last month, subject to the Administrator's confirmation and to import control. The contracts include two generator sets at £7,490, switchboards at £2,336, transformers at £1,136, h.t. switchgear at £1,109, steel poles at £542, and cables and accessories at £2,300. This gives a total of £12,613. It is hoped to get the new station in operation as quickly as possible, for the existing plant has worked almost double the period of its normal life.

Battery Chemicals

A sample order of 30 tons of maganese dioxide will be shipped shortly from Japan to Germany, it is reported. This is to be used in the manufacture of dry-battery cells. If the sample is satisfactory, Japan hopes to export between 300 and 400 tons monthly to West Germany.

PERSONALITIES

IN THE INDUSTRY

His many friends will be interested to learn that **Mr. R. W. L. Harris,** B.SC., M.INST.C.E., M.I.MECH.E., M.I.E.E., is shortly resigning from the post of Registrar and secretary of the Professional Engineers Appointments Bureau, which he has held since the Bureau started in 1945, in order to take up an appointment with Preece, Cardew and Rider. Prior to joining the Bureau he was on the staff of Kennedy and Donkin as a senior engineer for five years, being engaged on work for the C.E.B. and the Government of Northern Ireland, in addition to other clients.

Mr. R. W. L. Harris

Employed by the North Western Electricity Board at Bacup, as Rossendale district sales superintendent for the past two years, and previously on the staff of the Bacup Corporation Electricity Undertaking for 21 years, **Mr. A. Wilson** has been appointed a representative of the English Electric Co., Ltd., at Manchester.

The E.D.A. Domestic Electricity Salesmanship Diploma has been awarded to **Mr. A. Smith,** of St. Just, Penzance (South Western Electricity Board), and **Mr. C. S. Whitby,** of Luton (Eastern Electricity Board).

We offer our congratulations to **Mr. G. A. T. Burdett** of the Dowsett group of companies, who has been notified by the Air Ministry that he is to receive the Air Efficiency Award in respect of his services in the Royal Air Force Volunteer Reserve, which he joined early in 1939.

Mr. H. B. Rantzen, B.SC.(ENG.), M.I.E.E., head of the engineering designs department of the British Broadcasting Corporation, has accepted an appointment with the United Nations as director of telecommunications services.

On Friday last, **Mr. W. G. Turner,** M.INST.C.E., M.I.E.E., M.I.MECH.E., former manager of No. 3, Portsmouth Sub-area of the Southern Electricity Board, who has retired, was presented with a silver tea set by his successor, **Mr. E. A. Logan,** on behalf of the staff, as a mark of their appreciation.

Previously a second assistant in the Technical Department of the London Generating Division of the B.E.A., **Mr. S. J. Morley,** B.SC., A.M.I.E.E., has been selected as senior assistant to the technical engineer of the Merseyside and North Wales Division.

Mr. E. N. Rowbotham has been appointed chairman of Ever-Ready Co. (Gt. Britain) Ltd. Consequent on the death of the late Mr. Magnus Goodfellow, the functions of individual members of the Board have been reorganised. It is not proposed to make any appointment to the office of managing director for the time being.

Last month saw the retirement of **Mr. P. Jackson,** ASSOC. I.E.E., sub-area engineer No. 8 sub-area, East Midlands Electricity Board. To mark the occasion, presentations were made to him by **Mr. F. W. Godden,** sub-area manager, on behalf of his colleagues and the Long-Service Association. Mr. Jackson received his technical training in Salford, his home town, and joined the staff of the Coventry Corporation Electricity Department, in 1920. He was appointed deputy electrical engineer in 1942, and became sub-area engineer upon nationalisation of the industry.

In succession to Mr. P. Jackson, **Mr. K. Brown** has now been appointed to the position of sub-area engineer in the Coventry sub-area of the East Midlands Electricity Board. Mr. Brown was previously mains engineer in the Coventry sub-area, and, as such, has been responsible for the development of supplies in that region.

Mr. K. Brown

Mr. W. G. Cliff, who has been buyer and cashier of the Electric Construction Co., Ltd., Bushbury, for the past 18 years, has retired. He joined E.C.C. in 1894.

Mr. W. H. McFadzean, the chairman of the Telegraph Condenser Co., has resigned from the Board.

President of Ferranti Electric Ltd. of Canada, and a director of Ferranti Ltd., of England, **Mr. A. B. Cooper** B.SC.(ENG.) M.I.E.E., has been chosen as President of the Industrial Commission of Toronto, of which he is a founder member. Mr. Cooper is a past-president of the Canadian Electrical Manufacturers' Association.

Mr. J. R. Pheazey, M.I.MECH.E., M.I.P.E., works director of Standard Telephones and Cables, Ltd., and vice-president and European director of manufacture, International Standard Electric Corporation, has been elected President of the Engineering and Allied Employers' London and District Association.

W. T. Glover and Co., Ltd., announce that **Mr. E. L. Davey,** B.SC.(Eng.), M.I.E.E., formerly their mains cable engineer, has been promoted to chief engineer. In addition, **Mr. N. Divon,** A.M.C.T., A.R.I.C., F.I.R.I., who has been with the firm since 1909, is now appointed technical manager of the Rubber and Plastics Division.

We understand that **Mr. J. D. Abey,** commercial assistant in the Nuneaton District of No. 3 Sub-Area, East Midlands Electricity Board, has been promoted to commercial assistant (domestic development) in the Leicestershire and Warwickshire Sub-Area. He saw early service with the Scunthorpe Electricity Department and Johnson and Phillips, Ltd., before joining the Westmorland Electric Supply Co. He has been commercial assistant with the Nuneaton undertaking for the past 15 years.

Dussek Bitumen and Taroleum Ltd., announce the appointment to the Board of **Mr. E. R. Hatt,** M.Inst.P., secretary and general manager. In addition, **Mr. E. A. Deacon,** A.M.I.E.E., and **Mr. Eric A. Dussek** have been appointed associate directors.

About 500 members and guests thoroughly enjoyed the recent E.I.B.A. dance held at Tube Investments' Social Club at Oldbury, Birmingham, and which resulted in a welcome increase in the Association's funds. A grand array of prizes given by Midland electrical firms, was displayed and subsubsequently presented by **Mrs. Gibson,** wife of **Mr. H. J. Gibson,** A.C.G.I., B.SC., M.I.E.E., chairman of the E.I.B.A. Birmingham Area Committee and chief commercial officer of the Midlands Electricity Board. The organisation was in the hands of **Mr. L. Wall,** secretary of the Birmingham Area Committee, **Mr. J. M. Surrall** and **Mr. F. O. Rogers** of T.I.S.C., and others. The E.I.B.A. headquarters was represented by **Mr. L. C. Sharp,** chairman, and **Mr. H. S. Fothergill,** secretary, who was one of the prize winners. Our picture below shows, left to right, Messrs. J. W. Johnson, J. W. Donovan, A. M. Fletcher, L. Wall, J. M. Surrall, A. H. Adey, H. J. Gibson, B. Graham, F. O. Rogers, G. Redmond and G. H. Byron.

Dr. J. L. Matheson has been appointed Beyer Professor of Engineering and Director of the Whitworth Laboratories, Manchester University. Since January, 1947, he has occupied the Chair of Civil Engineering in the University of Melbourne.

Manager of the Sales Department of the General Accessories Corp. since August last, **Mr. T. A. Fielding** has relinquished that position and has joined Electrowares Ltd.

Last month, **Mr. P. E. Painter** retired from the position of chief cashier in the English Electric Co.'s London office.

In the new Parliament which met for the first time yesterday, the electrical industry has a number of representatives. Among the new Labour members (constituencies in parenthesis), we note the names of **Mr. F. A. Cobb,** Assoc. I.E.E., who has served with the B.B.C. and the Indian Broadcasting Co. (*Brighouse and Spenborough*); **Mr. T. F. Cook,** an electrician (*Dundee East*); **Mr. C. R. Hobson,** a power station engineer, who was for six years a member of the employee's side of the Electricity Supply J.I.C. (*Keighley*); **Mr. I. R. Thomas,** a former part-time member of the South Wales Electricity Board (*Rhondda West*); and **Maj. W. F. Vernon,** executive member of the Association of Scientific Workers (*Dulwich*). Among the Conservative members are: **Sir Peter Bennett,** O.B.E., head of Joseph Lucas Ltd. (*Edgbaston*); **Mr. F. J. Erroll,** M.A., A.M.I.E.E. (*Altrincham and Sale*); **Sir Arnold B. Gridley,** K.B.E., M.I.E.E., a director of many electrical concerns (*Stockport South*); **Viscount Hinchingbrooke,** who is connected with a group of electrical manufacturing companies (*Dorset South*), **Mr. O. Lyttelton,** chairman of Associated Electrical Industries (*Aldershot*), and **Mr. C. I. Orr-Ewing,** O.B.E., B.A., A.M.I.E.E., commercial adviser (technical) to A. C. Cossor, Ltd., and director of Cossor Radar, Ltd. (*Hendon North*).

Formerly mains superintendent to the East Retford district of the East Midlands Electricity Board, **Mr. J. P. Smith** has been appointed subdistrict manager and engineer of the Hornsea-Withernsea districts of the Yorkshire Board.

A happy group at the recent function of the E.I.B.A. at Oldbury, Birmingham

Undertakings' Statistics for 1947-48

THE last in the series of Returns of Engineering and Financial Statistics Relating to Electricity Supply Undertakings* covering the year 1947-48, has been released this week by the Ministry of Fuel and Power. It covers the last financial year completed or almost completed by undertakings before vesting; but for Scottish local authorities it relates only to a period of 10½ months. Many will feel that the thunder has already been stolen by the prior publication of the B.E.A.'s 1st Report, but there is much data which is not included in the latter.

A net increase of over 435,000 (3·8%) in the consumers connected is recorded, bringing the total to 11,916,942. Total sales of electricity during the period amounted to 35,983 million units, as compared with 35,059 million in 1946-47. Of that total, 15,981·7 millions (3% increase), were sold for lighting, heating and cooking, and 18,464·5 millions (2·9% increase) for power.

The total net revenue from working, exclusive of bulk supply sales, was £183,313,000, as against £175,690,000 in 1946-47, representing an average of 1·223d. and 1·203d. per unit respectively. For lighting, heating and cooking supplies, the average revenue was 1·391d. per unit in 1947-48 and 1·415d. per unit in 1946-47. For power supplies the average revenues were 0·907d. per unit and 0·884d. per unit respectively.

Net total working expenses of the undertakings amounted to £135,362,000 in the year under revue, of which the works cost of generation accounted for 57%, corresponding figures for the previous year were £121,688,000 and 58%.

At the end of 1947-48 authorised undertakings, including the C.E.B., owned or leased 348 generating stations, containing an aggregate of 12,951 MW. A total of 26,146,677 tons of coal and coke, at an average price of 49s. 4d. per ton, was consumed during the year 1947-48, plus 44,238 tons of oil fuel at £8 0s. 8d. per ton.

Of the £53,527,000 gross surplus in 1947-48, £19,471,766 went in interest and dividends, £2,308,341 to income tax, and £28,539,868 to depreciation reserve and renewal funds, loan repayments, etc. Some 109 local authorities appropriated £1,071,415 for the relief of rates, while a further six had to seek contributions totalling £21,189 to balance their accounts.

Of particular interest are the balances on hand at the end of the year. For the C.E.B. this amounted to £12,704,941, for public authorities £4,738,889, and for company undertakings £7,372,877; making a total of £24,816,707.

The C.E.B. also had £4,622,429 in its Reserve Funds and £21,106,543 in the Sinking Funds. Corresponding figures for public authorities were £17,688,747, and £15,289,166, while the depreciation and reserve funds of the companies held £160,690,508, making a grand total of £219,397,393.

The major part of the Return is devoted, as usual, to an analysis of the revenue, working expenses, plant, etc., of the undertakings.

---

*Published by H.M. Stationery Office. Price 30/-.

NEW LITERATURE

Electrical Trades Directory, 1950

IN addition to a further enlargement, a considerable degree of rearrangement has been made in this latest volume of the Blue Book. Much of the information which was formerly recorded in the Alphabetical Section has now been sectionalised under the specific headings of manufacturing, merchants, contractors, wholesalers, engineers, electricity supply, personal, etc. The Classified Section too has been expanded with further headings and sub-divisions, and the volume is completed with a Trade Names Section. This new method of grouping will be appreciated by many, although some may find the rearrangement a little puzzling at first. To assist the latter an alphabetical guide is included. Like its predecessors the volume should prove of inestimable value to traders and engineers in the industry. Published by Benn Brothers Ltd., 1,004 pages, 9½ in. by 5½ in. Price £2 2s.

Principles of Electricity and Magnetism

by G. P. Harnwell

WRITTEN primarily for experimental physicists, this work should nevertheless prove extremely useful to electrical engineers who desire a firm grounding in the theoretical basis of their subject. It has the advantage, from their point of view, that the advanced mathematics necessary in any such detailed treatment of the subject is here confined to differential and integral calculus, elementary differential equations, and vector analysis—with which techniques the electrical engineer is familiar.

The treatment adopted assumes a sound general knowledge of physics, and develops the subject from the basic experimental laws. In accordance with modern trend, the M.K.S. system of units is applied. Chapters on electrostatics, dielectrics and conductors are followed by a consideration of non-ohmic circuit elements and of alternating currents in relation to them. Chemical, thermal and photoelectric effects are next considered, after which the subjects of thermionic valves and conduction in gases are discussed. Electromagnetic effects, machinery and circuits come next, and the book ends with sections on LCR circuits, practical valve circuits and radiation.

A 28-page mathematical section completes this well produced book, while a collection of problems at the end of each chapter adds to its usefulness. Published by McGraw-Hill Publishing Co., Ltd., 670 pages, 9 in. by 6 in. Second edition, price 51s.

Low-Voltage Short Circuits

— their calculation made easy

THE ability to estimate possible short-circuits on low and medium voltage circuits is of importance to two distinct sections of the industry. The supply engineer needs to know the possible short circuits at consumer's terminals, in order that he may ensure that intake arrangements and main switchgear will provide adequate protection against faults which may occur. There is a considerable difference between the arrangements which will be required on an urban network within a few yards of a vault containing two 750 kVA transformers, and those which will be perfectly satisfactory in the case of a consumer at the remote end of a small feeder.

The Plant Engineer

The subject is also of importance to the plant engineer in a factory, particularly those of what might be classed as medium size. In the very smallest works the problems may not be any more important than would be the case in a large domestic installation, while the very large and up-to-the-minute plants have usually carried out intensive studies of their short circuit problems and taken appropriate precautions. In between, however, there are many industrial installations which, like Topsy, have "just growed" and extensions have been carried out haphazard without any real thought being given to the magnitude of fault currents which may be expected at any given location.

Points of View

There are normally two schools of thought on low voltage short circuits, the optimistic and the pessimistic. The optimistic tend to discount possible fault troubles merely because the voltage is low. An 11 kV system they would treat with respect, but a 440 V circuit does not seem very impressive, and they will cheerfully use the cheapest types of switchgear and re-wireable fuses, without giving a thought to the power which may be behind the fault. The pessimistic, on the other hand, have usually read somewhere or other that a circuit breaker opening on 25 MVA at 440 V is more highly stressed than a 33 kV breaker operating at 1,500 MVA, and are apt to accord exaggerated respect to all l.v. short circuits, irrespective of actual capacity. Neither really makes the effort to dig right into the particular problem, because it is not always easy to calculate short circuits on l.v. systems.

Effects of Resistance

The calculation of fault kVA on high voltage circuits is a comparatively simple affair providing the circuit is straightforward and does not include networks which enable a fault to be fed from two or three sources, and providing that percentage reactances of relevant apparatus are known. For example, an alternator having 10% reactance will give a short circuit of 10 times full load, and so on. The reactance of cables is also obtainable, so that the calculation of fault current at the end of a given feeder is a very simple affair.

On low voltage circuits, however, resistance is also important, and this tends to complicate matters. It is possible to work on reactance alone or resistance alone, but either will give a very pessimistic estimate of the fault current to be expected, and the problem will seem much more difficult.

An approximate method sometimes used is to work out the short-circuit based on reactance alone and to apply some arbitrary reduction factor, but the difficulty is to estimate a reasonable value for this. In order to overcome this difficulty, Trencham[1] and Mortlock[2] made a detailed investigation into the problem some years ago and obtained a large number of figures from which curves were plotted covering typical cases. Their investigations covered copper busbar conductors at various spacings, and single-core and 3-core cables. The present article deals only with the cable situation.

Method of Using Curves

Figs 1, 2, 3, 4 give values of reduction factor applicable for various lengths and sizes of typical cables, both 3-core and single-core, for 220 and 440 volts.

The short circuit MVA at the transformer or generator terminals is first estimated in the usual way from the normal rating of the machine and percentage reactance. This value

---

[1], [2] The British Thomson-Houston Co. Ltd. Willesden.

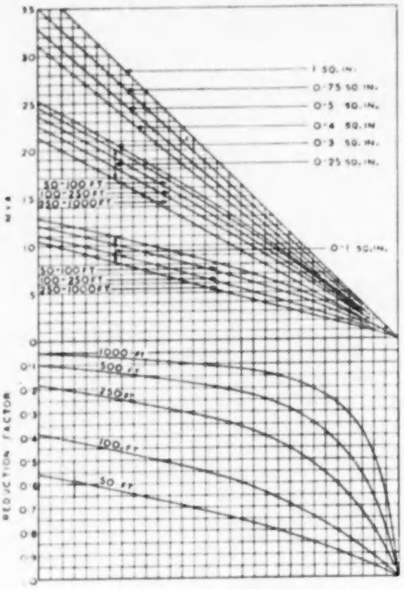


Fig. 1. Three-core cables, 220 volts

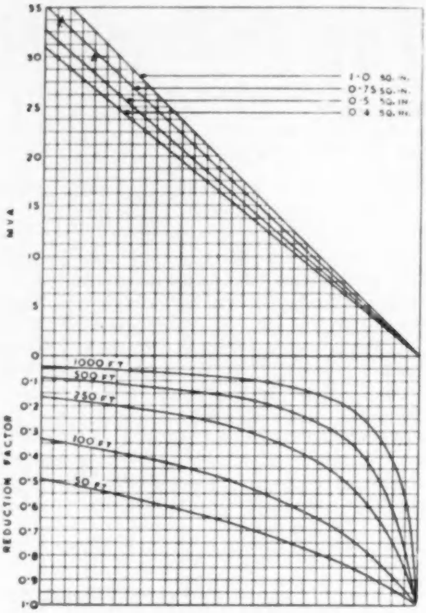


Fig. 2. Three single-core cables, 220 volts

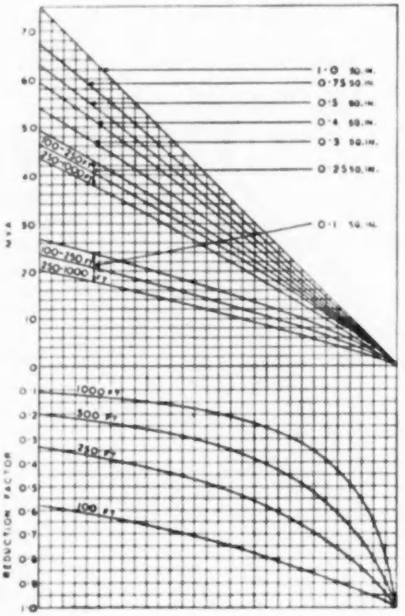


Fig. 3. Three-core cables, 440 volts

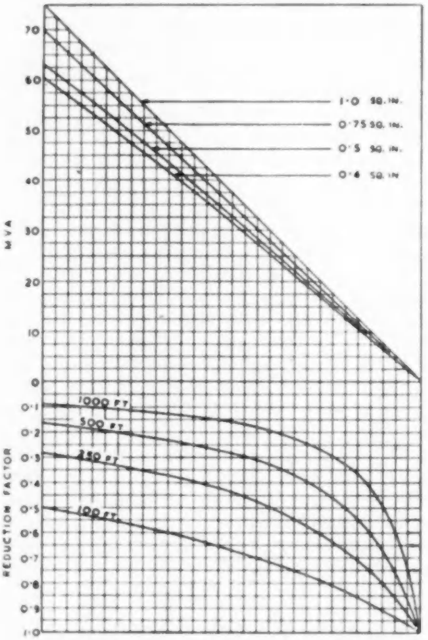


Fig. 4. Three single-core cables, 440 volts

of short circuit is then applied to the top set of curves for the appropriate cable. Where the top curve cuts the horizontal line at the appropriate MVA value, a perpendicular is dropped to intersect the appropriate lower curve, and the reduction factor value is read off opposite this point of intersection.

Typical Examples

Feeders in Series

In the case of two feeders in series (Fig. 5) the short circuit is first estimated at the intermediate point by applying the appropriate reduction factor to the input short circuit. This then becomes the input short circuit for the second section, and the reduction factor for the second cable is then applied to give the ultimate short circuit at the load end. Referring to Fig. 5, in which a 500 kVA transformer of 5% reactance at X feeds through a 500 ft length of 0·25 sq in. 3-core cable to point Y, which is again linked to point Z by another 1,000 ft of 0·1 sq in. 3-core cable:—

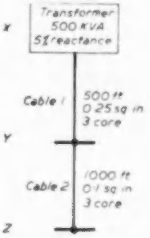


Fig. 5. Two feeders in series

Short circuit at X $= 500 \times \frac{100}{5} = 10$ MVA.

From Fig. 3, K_2 (reduction factor) for 500 ft of 0·25 sq in. 3-core cable = 0·6 ∴ short circuit at Y = 10 × 0·6 = 6 MVA.

From Fig. 3 again, K (reduction factor) for 1,000 ft of 0·1 sq in. 3-core cable at 6 MVA = 0·325 ∴ short circuit at Z = 6 × 0·325 = 1·95 MVA.

Feeders in Parallel

Where there are two feeders in parallel, as in Fig. 6 the procedure is to assume that the short circuit MVA will be divided between the two feeders so that the total reduction factor is the same as that for each individual cable. It is necessary to make a rough estimate of the proportion carried by each, and to revise this until the two reduction factors K_1 and K_2 are found to be the same. If the transformer capacity is 1,000 kVA with 5% reactance and the two cables are 250 ft long, one being 0·1 sq in. 3-core and the other 0·25 sq in. 3-core,

Short circuit at X $= 1{,}000 \times \frac{100}{5} = 20$ MVA.

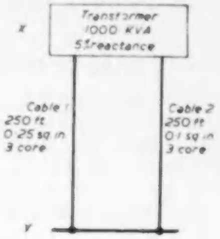


Fig. 6. Two feeders in parallel

Assuming that this is divided in various proportions, and obtaining the short circuit factor for each proportion we have :—

MVA for Cable 1	K1	MVA for Cable 2	K2
10	0·75	10	0·6
12	0·72	8	0·6
13	0·7	7	0·7
14	0·65	6	0·75

so that the overall reduction factor K_1K_2 is 0·7 and short circuit at Y = 20 × 0·7 = 14 MVA.

Feeders in Series and Parallel

In the case shown in Fig. 7 we have two feeders in parallel, one consisting of two cables in series. In order to calculate the short circuit at Z we first divide the input short circuit, in the same way as before, until we find a value of K_1 which is equal to $K_2 \times K_3$, the reduction factors for cables in series as in the first examples.

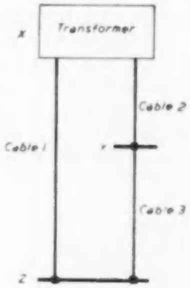


Fig. 7. Feeders in series and parallel. In this case point Y is fed from point X via Cable 2 and from point Z by Cables 1 and 3 in series

To find the short circuit at Y we reverse the procedure as Y can be considered as being fed from X by cable 2 direct and by cables 1 and 3 in series, so that we make new assumptions until we find values for K_2 which equal

$K_1 \times K_3$. The detail working is a little longer, but equally simple.

Effect of H.V. System Capacity

When the short circuit MVA of a transformer is worked out in the normal way, it assumes infinite capacity on the h.v. side. If, as is usually the case, the h.v. capacity is itself limited, the l.v. short circuit is, of course, reduced. Thus a 1,000 kVA transformer with 5% reactance gives us, in theory, $1{,}000 \times \frac{100}{5} = 20$ MVA. If on the other hand it were fed from an h.t. system with a maximum short circuit capacity of only 50 MVA it would reduce the l.v. fault value considerably. This is estimated by taking the h.v. short circuit and calculating the percentage reactance of the transformer on this basis, then adding this figure to the actual percentage reactance inherent in the transformer. In the above case, for example, the percentage reactance referred to the h.v. side is $\frac{1{,}000}{50{,}000} = 2\%$, so that the corrected figure for the transformer reactance is 7% and the maximum short circuit $= 1{,}000 \times \frac{100}{7} = 14{\cdot}33$ MVA and not 20.

Circular Calculator

Where a number of problems require solution with constant conditions of system voltage and type of cable, it is worth while saving time by constructing nomograms or even calculators of the circular slide rule type. Such a calculator has been constructed for 3-core cables on 440 V 3-phase circuits, and is published elsewhere in this issue. On one side (dial A) short-circuit MVA can be easily obtained by moving the dial until the percentage reactance of the transformer or generator is located opposite its kVA rating when the short-circuit MVA appears under the arrow. If the high voltage short-circuit capacity (in the case of a transformer) is known, the additional percentage reactance can be obtained by reversing this process, i.e. by locating the arrow on the s.c. capacity and reading the percentage reactance against the transformer capacity. *If the required figures cannot be brought on to the scale by virtue of a small transformer rating or a high fault capacity on the h.v. side it can safely be assumed that the added reactance is so small as to be negligible.*

On the other side, the limiting effect of cable is taken into consideration. The cut-out window is moved to the sector nearest to the short circuit MVA at the transformer terminals, and adjusted until the required length figure appears in the window. The reduced short-circuit MVA for this length of feeder then appears against the figure for the cross-sectional area of the cable. (Note: If the figure appears in bold face type then it exceeds the maximum permissible 1-second rating for the cable.)

Single Phase Faults

Paradoxical as it may seem, the phase-earth fault current is approximately equal to the phase/phase fault, so that there is no difference in duty, with a given transformer, whether one considers a 3-phase 440 V fault or a single phase 245 V fault. This can be seen by considering the sequence networks. For a single phase fault to earth, the sequence current is equal to the phase volts divided by the sum of positive, negative and zero sequence impedances. The actual fault current is 3 times the sequence current. In the case of the 3-phase fault the sequence current is equal to the phase volts divided by the positive sequence impedance and the fault current is equal to the sequence current.

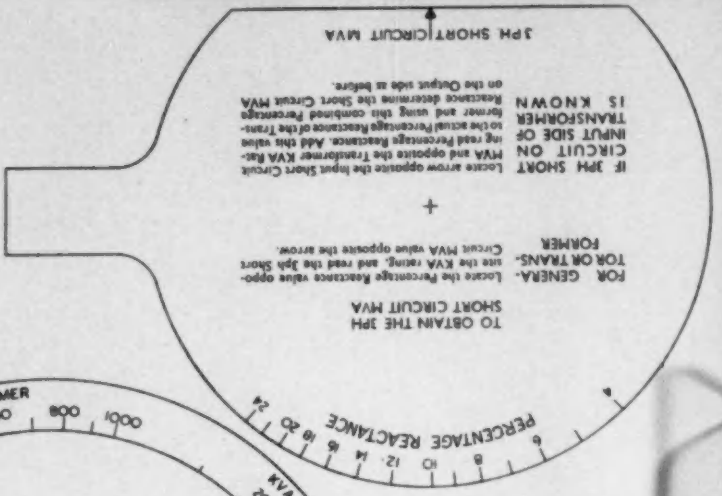
If, therefore, the positive, negative and zero sequence impedances are identical, the phase to earth fault current will be exactly the same as that for a three-phase fault. This condition will exist for faults in the immediate neighbourhood of the transformer. With faults remote from the transformer, the zero sequence impedances would rise to about 3 times the positive sequence impedance and consequently the single phase to earth fault current will be of the order of 60% of the 3-phase fault current.

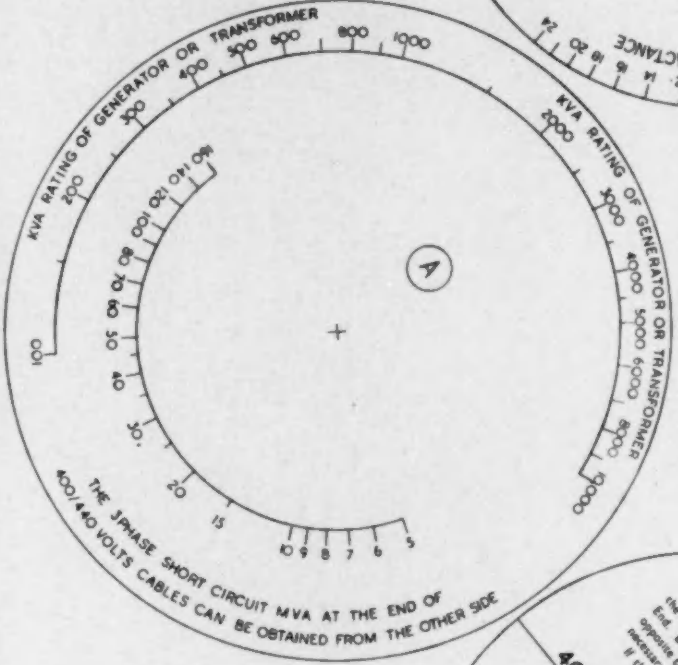
In all the above it has been assumed that the fault has been bolted, i.e. that there is no resistance in the fault itself. This may be considered pessimistic but such types of fault have occurred, and as switchgear is designed to cover the limiting condition, no allowance should be made for fault impedance. For the same reason, no allowance is made for the impedances of current transformers and circuit breakers, partly because they are small, and partly because they are very variable. In effect, the results are pessimistic but it is preferable that it should be so.

It is hoped that the information given will form some reliable basis for estimating low-voltage faults, and will eliminate much of the "guesstimating" which is still very prevalent.

We are indebted to the British Thomson-Houston Co., Ltd., for permission to reproduce the curves and calculator (designed by Dr. J. R. Mortlock) accompanying this article.

A →


3PH SHORT CIRCUIT MVA
IF 3PH SHORT CIRCUIT ON INPUT SIDE OF TRANSFORMER IS KNOWN
Locate arrow opposite the Input Short Circuit MVA and opposite the Transformer KVA Rating read Percentage Reactance. Add this value to the actual Percentage Reactance of the Transformer and using this combined Percentage Reactance determine the Short Circuit MVA on the Output side as before.
FOR GENERATOR OR TRANSFORMER
Locate the Percentage Reactance value opposite the KVA rating, and read the 3ph Short Circuit MVA value opposite the arrow.
TO OBTAIN THE 3PH SHORT CIRCUIT MVA
PERCENTAGE REACTANCE
6
8
10
12
14
16
18
20
24


KVA RATING OF GENERATOR OR TRANSFORMER
100
200
300
400
500
600
800
1000
KVA RATING OF GENERATOR OR TRANSFORMER
2000
3000
4000
5000
6000
8000
10000
A
160
140
120
100
80
70
60
50
40
30
20
15
10
9
8
7
6
5
THE 3PHASE SHORT CIRCUIT MVA AT THE END OF 400/440 VOLTS CABLES CAN BE OBTAINED FROM THE OTHER SIDE

Low Voltage Short Circuit Calculator

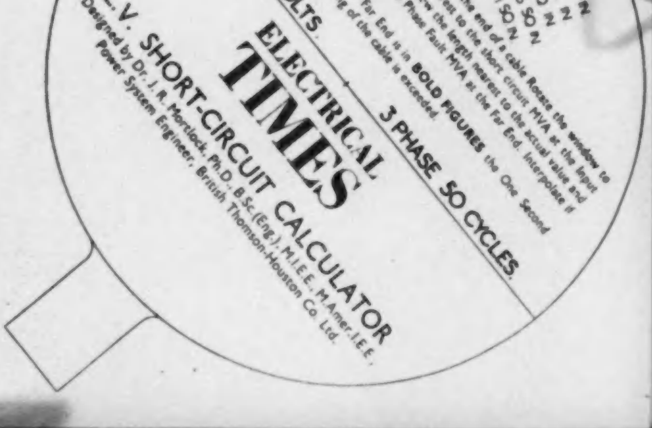
Supplement to

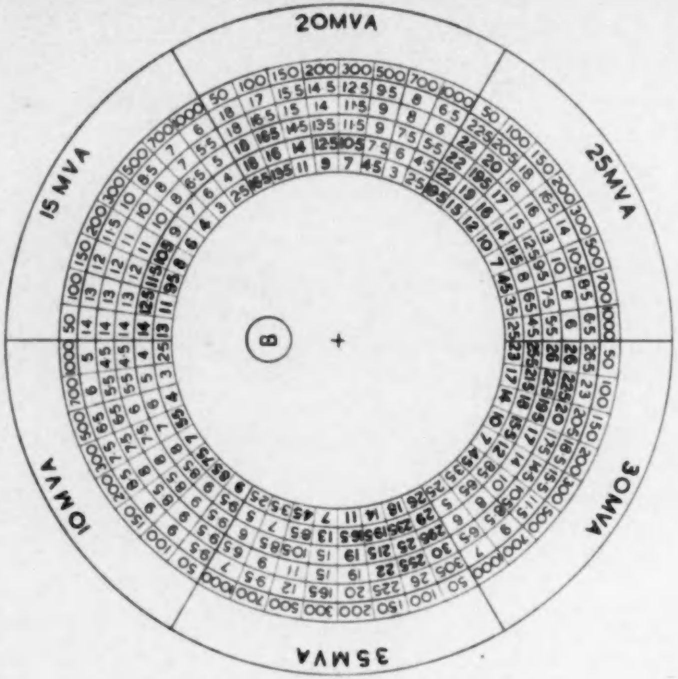
ELETRICAL TIMES

March 2nd, 1950

Cut out dials A and B and the shaded window on dial B and assemble on appropriate sides of double-sided centre dial, using eyelet or small rivet as pivot.

B →


LENGTH 3 PHASE 3 CORE CABLES
IN FEET
1·0 SQ. IN.
0·5 SQ. IN.
0·4 SQ. IN.
0·25 SQ. IN.
0·1 SQ. IN.
To obtain the 3 Phase Fault MVA at the end of a cable Rotate the window to the sector with the MVA heading nearest to the short circuit MVA at the Input End. Locate at the top of the window the length nearest to the actual value and opposite the cable Size read the 3 Phase Fault MVA at the Far End. Interpolate if necessary.
If the MVA Value at the Far End is in BOLD FIGURES the One Second Rating of the cable is exceeded.
400/440 VOLTS.
3 PHASE 50 CYCLES.
ELECTRICAL TIMES
L.V. SHORT-CIRCUIT CALCULATOR
Designed by Dr. J. R. Mortlock, Ph.D., B.Sc.(Eng.), M.I.E.E., M.Amer.I.E.E.
Power System Engineer, British Thomson-Houston Co. Ltd.


20MVA
25MVA
30MVA
35MVA
10MVA
15 MVA
B

Problems and Practice

IN ENGINEERING

Lost Volts

A LOCAL printing works reported that they were unable to operate their motors although lighting was normal. The supply was 460/230 V, d.c., 3-wire. An electrician was sent to investigate, but was unable to find any fault on the installation, and voltage was normal at the cut-out. He noticed that when attempts were made to start the machinery the lights dimmed out completely. After a further check of the installation, he decided it must be mains trouble and notified that department. In the meantime the works manager was tearing his hair, as he was in the middle of printing papers and periodicals which had to catch that night's train. The mains engineer then carried out "combined operations" with the installation staff, and a voltmeter was put across the positive and negative terminals while an attempt was made to start the motors. The voltage immediately fell to about half value, but recovered when the machinery was switched off.

A check was made at an underground box some distance down the road, where it was found that the pressure was not affected by the machinery load. It was now late at night, and to locate the fault on this last section and rectify it would take at least all night, so some means had to be found of providing a temporary supply to allow the works to continue printing. A test of the voltage conditions was made at the cut-out of a 460/230 V service some yards down the road and revealed that it was unaffected by the printing works' motors. From this cut-out an "overhead" service was run in t.r.s. resting on six-inch nails driven into the walls and brought into temporary cutouts at the printing works. This 2-core cable provided positive and negative. For neutral the existing underground service neutral core was used, and the works manager was a happy man again.

The following morning the mains (v.i.r. in bitumen-filled wooden trough) were excavated at a suspiciously fresh disturbance in the road, and it was found that damage had been caused by a contractor's labourer's pick when laying a pipe for a water service. This misguided implement had ploughed through trough, bitumen and positive core, leaving point-to-point contact on two strands and, of course, the IR drop across this, while negligible on lighting load, soon showed up on the heavy motor currents.

The point is worth bearing in mind, as exactly the same symptoms would be apparent in the case of poor contacts at substation fuse panels, pillars, link boxes and joints, and much time can be wasted checking over a consumer's installation.—*R. Lloyd Evans.*

Everyday Fluorescent Faults

OUR establishment is fitted out with something like 300 fluorescent fittings mostly of the sealed type starter switch variety. Naturally, it is not an uncommon complaint that somewhere in this large building a lamp is faulty, the most common fault being "lamp blinking on and off."

Invariably, the easiest lines are followed to effect a cure, namely, the starter is changed and, if this fails, out comes the tube. Now, with all due respect to the makers of starter switches, a new switch is sometimes found to be faulty and, after having changed the tube and starter, you are obliged to investigate elsewhere for trouble, e.g., the choke.

The following I found to be a positive and time-saving check for locating a faulty starter or lamp. Having removed the interior of an old starter, leaving just the connecting pins and case, I strapped the heater contact pins and brought the switch contacts out via flex to a push button. This proves to be a handy test jack. Insert the jack into a starter socket and, by depressing the push button on and off, the lamp can be easily checked.—*S. A.*

Contact Wear

RECENTLY I was asked to inspect a large pump motor; as it was running warm and had an unusual note. I made usual tests and observations; it seemed and was finally proved a two-phasing note. Fuses were in order, contacts of combined starter, for stator and rotor were passed as in good order. A current reading was taken and out of balance was definite; therefore, I decided that insulation between turns had broken down, and removal was prepared for. Not being fully satisfied, another check was made, fuses, etc., starting up was done with starter cover off. It was noticed that section of starter controlling the low reading phase, had a slight arc at the end of its travel.

On examination it was found that the contact was good until end of travel was reached, and then a clearance of approximately 0·002 in. was effected, attributed to long and continuous service. This, of course, was corrected and no further trouble ensued.—*R. Woodhouse.*

Speedy Drying Out

SOME few years ago a report came from a steel works that one of their rolling mill motors was saturated with water. The machine involved was a d.c. 500 volt 1,200 b.h.p. On arrival it was found that the report was by no means exaggerated as they had already mopped up three pails of water from the machine. The motor had been idle for a few weeks, and a severe frost set in followed by a rapid thaw. Condensation was the answer. An urgent order was booked which could be done only by this mill. There was no point in applying an insulation test, as a 250 volt lamp applied to the commutator indicated full glow. Obviously the dry-out of a unit of this size must be done on site. It was also realised that the usual methods of electric radiators or other heat-producing devices would take far too long.

On inquiry it was found that they had a semi-portable blower directly coupled to a 16 h.p. motor. They also had a considerable number of electric radiators, fortunately (as will be explained) of the mica-bar type with three in series, loading 1 kW at 250 volts. The mica units were stripped from the heaters and assembled inside the discharge pipe of the blower. Under windage, the units, when connected three in series only produced a black heat. As an experiment all the single units were connected in parallel across a 250 volt supply. Under the air blast the units closely approached a state of incandescence. To prevent a burn-out of the heating elements due to the blower motor kicking out, they were connected in parallel with the fan motor armature. A separate switch in series with the elements allowed the heaters to be switched on under full blast conditions only.

After a six hours run no apparent glow was observed in the lamp when connected to the commutator, but the insulation test was zero. A further test was taken eight hours later—the armature was up to 0·1 MΩ and the shunt field 0·3 MΩ. It was now decided to run the machine at a reduced voltage, viz. 150 volts with a water barrel resistance in series. The air blast was continued under the slow speed running for another six hours. The armature insulation rose to 0·25 MΩ and the field 0·4 MΩ. The machine was then put on its normal rolling duty. Time in all—twenty-four hours.

To prevent a recurrence of condensation, when the motor was not in use, the owners were advised to use a radiator in the machine pit and cover the entire unit with a heavy texture dust sheet. To the best of our knowledge there has been no repeat of condensation. —*F. Mackintosh.*

No Neutral

TWO blocks of terraced houses, fed by an overhead line from a substation some distance away, were complaining of voltage troubles, and load conditions on a nearer substation having improved, it was proposed to connect the section to this substation. The supply was disconnected for about half an hour whilst the "jumpers" on the line were disconnected, then the foreman on the job inserted the fuses of the distribution unit connecting the line to the busbars of the new substation and went to another job.

That evening a complaint was received that a house in this district had no light, on going along there, it was found that everything in the house was in order. Enquiries at the next house elicited the fact that the wireless had been working normally but had slowly got fainter and fainter until it went off altogether. As the whole block was fed from the red phase, enquiries were made at two semi-detached houses fed from the yellow phase. Here the light was on and, said the tenant, it was much better since changing over to the new substation.

Examinations showing that the remaining block of 15 houses were fed off the red phase also, investigations were switched to the substation, where the cause of the trouble was immediately apparent; the neutral link being still disconnected. As the feeder supplied only about 35 houses, of which all but two were connected to the red phase, the parallel impedances of the lamps and apparatus on the red phase gave a low voltage across them whilst the few lamps in the two houses on the yellow phase had a very high voltage across them. The fading wireless was accounted for by a reduction in the load impedance as extra lamps on the same phase were switched on. This experience demonstrates how essential it is that the neutral is opened last and made first.—*J. P.*

Contributions to this page, dealing with specific problems and items of interest to practical engineers are welcome, and will be paid for at our standard rates. Items should be brief, and preferably accompanied by diagrams or sketches, which will be redrawn for publication.

Contributors should state whether or not their names are to be published if their notes are accepted.

Busbar Zone Protection

By the Reyrolle "Mono-Bias" System

THE occurrence of busbar faults in large power stations can result in serious damage to machines and plant, and although these faults are comparatively rare, the risk involved by omitting appropriate busbar protection is, in many cases, not justified on economic grounds. It has, in consequence, become general practice to fit some form of busbar zone protection. The criteria for such protection are that the equipment must only respond to faults within the busbar zone and must not be affected by external faults on the outgoing or incoming feeders.

The development by A. Reyrolle and Co. of the Mono-Bias system fulfils these requirements by an ingenious method, involving the use of the well-known Merz-Price principle.

Basic Principles

The essential connections of the system are shown in the Fig. 1 which illustrates its application to a single section of busbar with four circuit breakers. Each primary circuit has three current-transformers with their secondaries in parallel and connected through opposite polarity rectifiers to two-bus wires A and B. The master relay may be regarded (for the purpose of explaining the method of operation) as having two equal bias-coils connected across the bus wires and an operating-coil connected between the junction of the bias coils and the common bus-wire joining one side of the current transformers.

During an external fault, the total amount of current flowing into the busbars is equal to that flowing out. Thus, while current is fed from one transformer group through a positive connected rectifier to bus-wire A, an equal current is fed from bus-wire B through a negatively connected rectifier to the other transformer group or groups affected. This applies to both half-cycles. The bias coils a and b, therefore, carry full wave rectified current, the value of which is the secondary current equivalent to the arithmetic sum of the outgoing or incoming fault currents. The operating circuit on the other hand carries the difference between the current fed into bus-wire A and the current fed away from bus-wire B; i.e. the vector sum of the secondary equivalent total fault current. This should be zero with an external fault, but in practice there is always a slight spill-over. However the bias coil influence restraining the relay is much greater than that exerted by the operating coil and the relay itself does not operate.

If an internal fault occurs, the direction of the fault current at any instant is the same in all circuits in which it flows. Thus, during one half-cycle, the secondary current from the current transformer groups carrying fault current

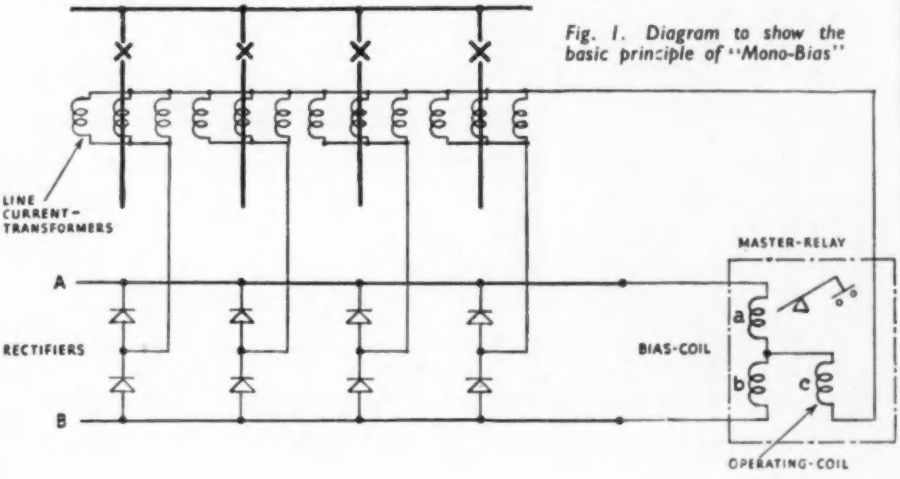


Fig. 1. Diagram to show the basic principle of "Mono-Bias"

is fed through the positively connected rectifiers to bus-wire A through the bias coil a, the operating coil c and back to the transformers by the common wire. In the next half-cycle, the secondary current is fed from the current transformer common bus-wire, through the operating coil c and the bias coil b, and back through the negatively connected rectifiers to the appropriate current-transformer groups. Thus the coil c carries the secondary current equivalent to the total fault current, whereas the bias coils a and b carry alternate halves of secondary current in the same direction. Thus the operating ampere-turns exceed the bias ampere-turns and the relay operates.

Practical Equipment

The schematic diagram of connections shows a beam type relay in use; in practice, this would lead to possible mechanical difficulties of maintenance, and a special type of relay has been designed. This consists of three components; a relay-transformer, a bridge rectifier, and a telephone type relay, as shown in Fig. 2. The bias coils, a and b, are wound on the centre limb of a three-limbed high permeability transformer core and the operating coil c consists of two windings in series, one on each outer limb. The middle limb has also a short-circuited winding and the outer limbs two output windings in series to the bridge rectifier.

The bias coils, during external faults, carry a full-wave rectified current equivalent to the fault current. This produces a practically constant unidirectional flux in the middle and outer limbs, as the short-circuited winding acts so as to prevent flux changes; i.e. it performs a "smoothing" function. As the core is highly saturated, even relatively large out-of-balance currents in the operating coil cause practically no flux changes and, therefore, no output to the d.c. supply. With internal faults, however, the biasing effect is reduced to one half the value found with an external fault since the current flows in the bias a and b only in alternate half cycles and the operating coil c carries the secondary equivalent of the total fault current. The a.c. operating ampere-turns now overcome the biasing ampere-turns, produce flux changes in the limbs and thus provide an output from the secondary windings to operate the d.c. relay. An operating time of about 60 to

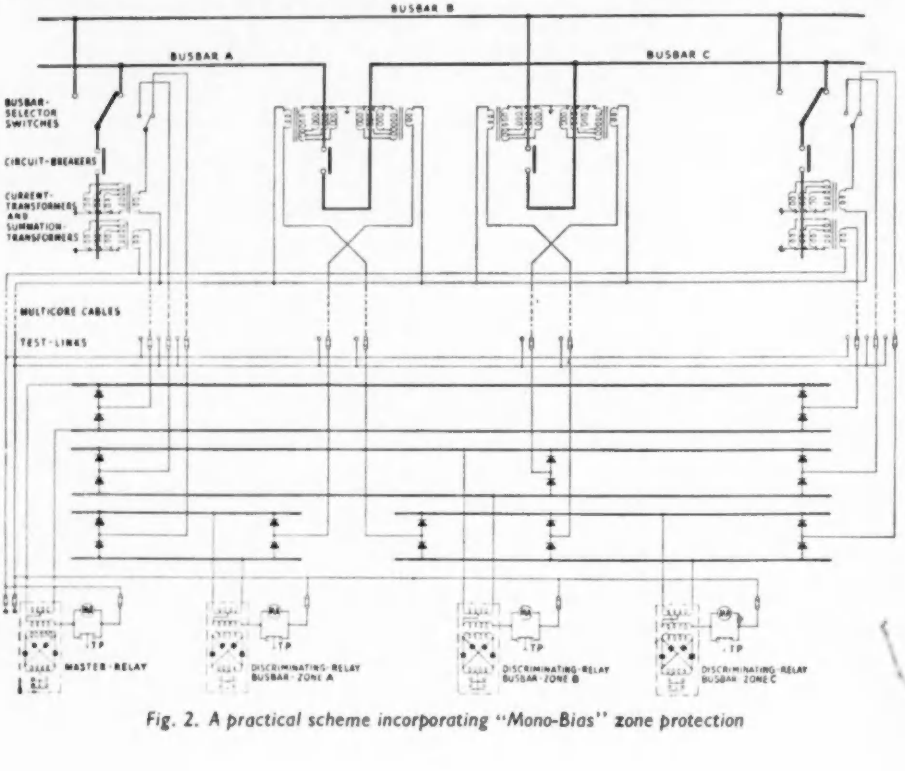

BUSBAR B
BUSBAR A
BUSBAR C
BUSBAR-SELECTOR SWITCHES
CIRCUIT-BREAKERS
CURRENT-TRANSFORMERS AND SUMMATION-TRANSFORMERS
MULTICORE CABLES
TEST-LINKS
TP
MASTER-RELAY
DISCRIMINATING-RELAY BUSBAR-ZONE A
DISCRIMINATING-RELAY BUSBAR-ZONE B
DISCRIMINATING-RELAY BUSBAR-ZONE C

Fig. 2. A practical scheme incorporating "Mono-Bias" zone protection

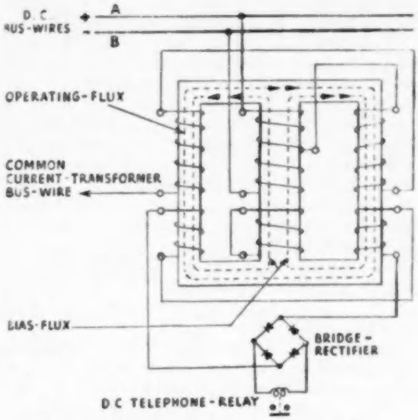


Fig. 3. The "transductor" relay system

70 millisecs at a fault current of three times the fault setting is usual. This includes the time for the tripping telephone type relay and a high-speed repeat contactor which is used for controlling the circuit breaker tripping circuits.

The system as shown in Fig. 1 produces a biasing effect with external earth faults,but stability would depend entirely on the balance of the current transformers with phase faults. To provide, therefore, a definite biasing effect with all types of external faults, the groups of current transformers are connected to summation transformers as shown. The biasing-effect with external phase-faults is not so great as with earth faults, but as under these circumstances a much better balance exists between the current transformers, less biasing is necessary.

Another advantage of the summation transformers is that they enable the overall ratio between the current transformers and the relay circuits to be increased to such an extent that the lead burden is reduced to negligible proportions. Thus the total burden imposed on the current transformers by the protective gear is so small that they may be considered as working practically under short-circuit conditions.

Testing

Last week, we witnessed extensive tests carried out on this form of protective gear. The conditions simulated were that of three busbars fed by six circuits and with a fault on a seventh. Nine double-wound 132 kV post-type current transformers, each with two primary turns were used for the six circuits, and these were balanced against three 132 kV post-type current transformers each with twelve primary turns. Sets of oscillograms, showing the currents flowing in various parts of the circuits were taken, as were also figures of the primary current in amperes required to operate the relay under various types of fault.

The tests also included a series of stability tests for various fault conditions and with faults on the rectifiers. The overall time of operation of the equipment was taken by means of an electronic timer which read in millisecs the time from the making of the fault current circuit breaker to the time of contact making on the tripping relay. A repetition of the tests was also given using bushing type current transformers.

In the general discussion following the tests, particular reference was made to the operating time of the equipment which varied between 109·6 and 73·6 millisecs. It was pointed out, however, that under test conditions it was impossible to reproduce the fault currents which would flow in the event of a busbar fault. The higher the fault current the quicker the rate of operation. There was, however, an inherent delay in the system imposed by the time needed for building up the fluxes in the current-transformers, the summation transformers and relay transformer, apart from the relay operating time delay.

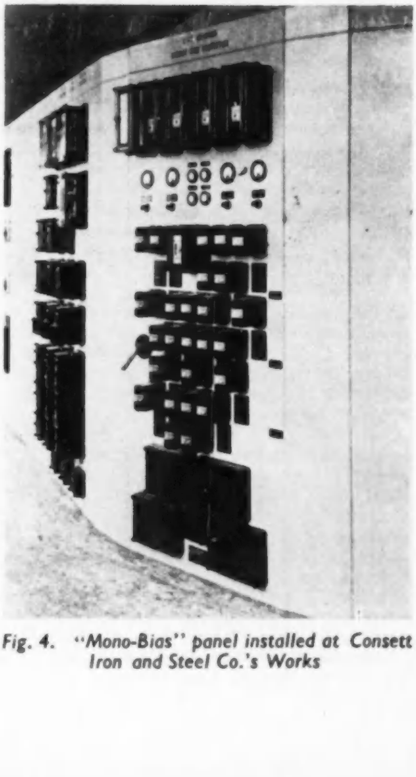


Fig. 4. "Mono-Bias" panel installed at Consett Iron and Steel Co.'s Works

The Arts at the I.E.E. Dinner

SIR GERALD KELLY, president of the Royal Academy, and Sir Malcolm Sargent were amongst the distinguished guests at the annual dinner of the Institution of Electrical Engineers last Thursday, which was attended by some 650.

The present day position of art and science were compared by Sir Gerald Kelly, in proposing the toast of "The Institution of Electrical Engineers," which he did in a light-hearted and humorous vein. It was, he said, useless to make a conventional approach to the toast, since the members would not relish inaccuracies about themselves, and frankly, his knowledge of electrical engineering was limited to some lines of Hillaire Belloc:—

> "Lord Finchley tried to mend th' electric light
> Himself. It struck him dead—and serve him right
> It is the duty of the wealthy man
> To give employment to the artisan."

The Royal Academy School was the only school of fine art for more than 100 years. Nowadays, he said, there were far too many schools and far too many students. The fact that some 20,000 students a year were being "processed" led him to take a gloomy view of the future, and he implied that artists were not needed—if they had been electrical engineers their future would have been rosier. There was little similarity between the artist and the scientist. The young scientist stands on the shoulders of his predecessor and was given, as a matter of course, information and facts which Faraday never knew. The young artist starts at the beginning and learns all slowly and painfully. In many ways he envied electrical engineers, one particular reason being that the amateur did not criticise their work.

Professor Moullin, replying, referred to the widespread nature of the Institution membership, and the number of guests present from overseas. It was an honour to preside at this family banquet. To Sir Gerald Kelly, he gave a message of greetings and goodwill to the Royal Academy.

"Our Guests"

"Our Guests" was proposed by Mr. T. G. N. Haldane (immediate past-president), who referred to the presence of distinguished representatives of the arts, the Commonwealth, the Civil Service, public bodies and the fighting services in addition to other distinguished men, paying particular tribute to Sir Malcom Sargent, who had done so much to spread British musical genius abroad.

Sir Malcolm Sargent, replying, said that his achievement was as nothing compared with that of the recording engineer, who had made it possible for a musician to examine his earlier work again. He concluded by quoting Rabindranath Tagore: ". . . Mine eyes have seen . . . I have done what I could."

BRITISH STANDARDS

Fusion-Welded Pressure Vessels. *B.S. 1500: 1949. Price 25s.*—Intended for the chemical and allied industries, this provisional standard represents the first stage in an important programme of work, intended to finish with the provision of a comprehensive code covering the construction and use of pressure vessels. Since this is a code, many of the requirements are not mandatory, and, indeed, some of the pressure vessels concerned are already dealt with by separate specifications.

Section one of the publication deals with definitions and with the use of the code, while section two indicates the range of materials covered and lays down stress limits. Section three, covering 84 pages of the 162-page document, deals with various aspects of design, and section five with fabrications. The remaining sections of this comprehensive code, comment on which is invited, are concerned with inspection and tests, protective devices, service inspection and repairs.

Press Tool Sets.—*B.S. 1609. Price 10s. 6d.*—Dealing with press tool sets for use with single-acting presses, this new British Standard gives dimensions for guide posts, guide bushes, and screwed and flanged shanks. It consists mainly of a series of dimensioned drawings of component parts, but includes some general requirements for the materials used, and sets out the information to be given by firms in tenders.

An extensive appendix defines and illustrates the applicable terminology.

Reciprocating Internal Combustion Engines (Excluding Carburettor Type).—*B.S. 649: 1949. Price 2s.*—Standards which were replaced by the original (1935) issue of this specification dealt mainly with gas and heavy oil engines for electrical purposes. After giving definitions and setting out its scope (engines "for marine auxiliary and for stationary and industrial purposes"), the standard lays down ambient conditions of engine working for the purpose of rating, and proceeds to lay down the margin of capacity, governing action, and standard equipment. Tests, tolerances and method of stating fuel consumption are also dealt with. A final section deals with the selection of an engine for use with an electrical generator, and an appendix sets out the information that should accompany an enquiry for an engine.

Identification Numbers for Cylinders of Internal Combustion Engines.—*B.S. 1599: 1949. Price 2s.*—Of interest to all users of i.c. engines, this specification consists mainly of a collection of sketches and definitions which gives a consistent method of cylinder identification for a wide variety of engine assemblies.

British Standards can be obtained from the Institution at 24 Victoria Street, S.W.1 at the prices stated.

The BUYER'S *Column*

Hairdryer—styled by G.E.C.

OF particularly pleasing modern design is this hairdryer just released by the General Electric Co., Ltd., of Magnet House, Kingsway, London, W.C.2.

The D.M.395 dryer

Weighing only 2 lb, the hairdryer has a well designed handle, comfortable to grip, which incorporates two control switches. These provide easy adjustment for hot or cold air and for switching on and off.

The body of the dryer is in cream plastic moulding and the aluminium die-cast base in which the dryer can be mounted is cream enamelled. The dryer with the heating element switched on consumes 580 W, whilst the motor itself uses 30 W. Catalogue number of the new dryer is D.M.395; the price is £4 4s. Purchase Tax £1 1s., whilst the stand which is supplied as an extra (Cat. No. D.M.396) costs 16s. with Purchase Tax 4s. Purchase tax does not apply when the stand is ordered separately.

Heat treatment and welding

MILD steel structures after welding may, in general, benefit from some form of heat treatment, this falling into one or more of the following classes—stress relieving, normalising or annealing. The need for this treatment and the general considerations to be kept in mind when applying it were the concern of a committee of the British Welding Research Association, and this body's recommendations have now been published in a booklet "Heat Treatment of Welded Constructions in Mild Steel," available price 1s. 6d. from the B.W.R.A., 29 Park Crescent, London W.1.

A timing changeover switch

ANNOUNCEMENT by Time Switches and Instruments Ltd. of 5 Victoria Street, London S.W.1 gives details of a recent addition to their range of timing devices.

Their new timing changeover switch will interest all makers of switchgear, particularly those connected with the laundry and chemical industries and the advertising sign business.

A synchronous motor, through a series of cams, actuates a mercury changeover switch. These cams are adjustable to various timing variations. The gearing of the motor is also adjustable to give any number of r.p.m., thus affording a complete range of time adjustments.

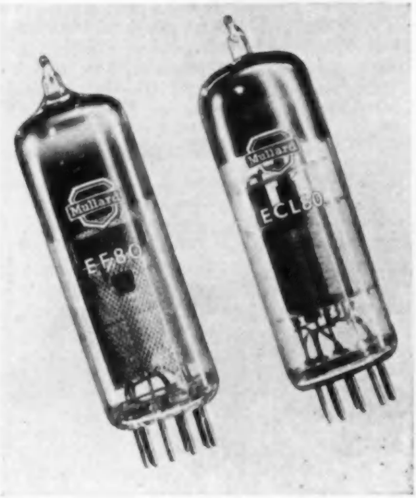
Housed in a robust pressed steel case, the switch is available for voltage ranges of 200/250 V and 400/440 V.

Screwdriver tests circuits

A USEFUL tool in itself, the insulated screwdriver marketed by Ben Sless (Tools) Ltd., Park Cross Street, Leeds, has the additional advantage of acting as an electric mains tester. A neon lamp is fixed in the handle and when the blade is in contact with a cable at 200 V or more to earth, the lamp glows, thus indicating that the circuit is live. Sold under the trade name "Wendor," this useful instrument sells at 9s. 6d.

Valves for viewers

TWO new nine-pin base valves have recently been added to the range of television products manufactured by Mullard Electronic Products Ltd., Century House, Shaftesbury Avenue, London W.C.2. One of these is an h.t. pentode, EF80, which is intended for use as an r.f. amplifier or mixer valve in receivers. Its particular advantage is operation with an h.t. voltage of only 170 V. The other valve, a triode pentode ECL80, has a wider range of applications.

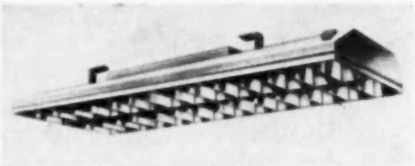


The two new additions to the Mullard range

Shop window lighting by "Ekco"

EKCO-ENSIGN ELECTRIC LTD., of Southend-on-Sea, Essex, announce two new shop-window lighting fittings for use with 40 W 4 ft fluorescent lamps.

These fittings—Nos. FF4/111 (single lamp) and FF4/211 (twin lamps)—are designed to light shop windows and large showcases effectively with the 40 W fluorescent lamps. They are also suitable for floodlighting display areas and backgrounds. Special attention has been given to the contour of the reflectors to ensure the maximum of light projected. The tilt is adjustable so that the beam can be directed to cover the display area adequately. The fittings are in three main parts, specular anodised aluminium reflectors, housing, fabricated from mild steel sheet containing the reflectors, lamps, lampholders, starter switches and sockets, and the two brackets on which the fitting is installed. Louvres and flush mounting angles are available as additional accessories at extra cost.

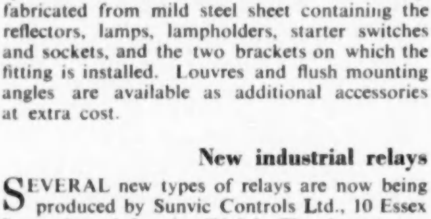


New industrial relays

SEVERAL new types of relays are now being produced by Sunvic Controls Ltd., 10 Essex Street, Strand, London W.C.2. They incorporate the Sunvic Hotwire vacuum switch capable of handling up to 10 kW at 440 V and are suitable for a.c. or d.c. use. Eleven new types, with from one to three tubes, are available. They are described in Leaflet P.N.10 which will be sent on request. As before, relays in Bakelite boxes or loose tubes can be supplied.

Cheer for American homes

BUILT by Belling and Co., Ltd., Bridge Works, Enfield, Middlesex, for distribution in the dollar countries are these specially designed "glow logs." They are intended to simulate a log fire and to add the cheer which a log fire brings, to the centrally heated homes of our friends across the Atlantic. Strongly built and reinforced, the "logs" incorporate the Belling "flicker" effect. Dimensions are 22 in. x 12 in. x 9½ in. Although a unit designed to fit a standard 16 in. basket grate will be shown at this year's Ideal Homes' Exhibition at Olympia, the "logs" are at present not available in this country.



Belling "logs" for the American market

Safety guard for fires

ACCIDENTS in the home are particularly distressing, and those involving disfiguring burns especially so. Of these, several each year are caused by careless use of electric fires, the bare elements of which readily ignite flimsy dress materials. As a protection against this type of accident the "Flamguard," manufactured by the Flamguard Co., Lotus Works, Heigham Road, London E.6, has much to recommend it. Consisting essentially of special quality clear mica which will withstand hard blows, held in a soft metal frame, it is readily fixed to most fires so as to completely shield the element. Various sizes of guard are made, and prices range from 2s. 9d. for a 4 in. guard to 4s. 6d. for a 14 in. long model. For the contractor, the Flamguard has the advantage of storing flat, being readily bent to shape for fitting round the fire.

Notes on resistance alloys

NICHROME is a widely known name in electrical engineering, and most people in the industry will find useful a new data book published by the makers of that series of alloys, British Driver-Harris Co., Ltd. In addition to details and notes on the properties of 80/20 and 65/15 nickel/copper alloys, there is similar information about "Comet," an oxidation-resistant nickel-chromium-iron alloy, "Advance," a 60/40 copper/nickel resistance alloy, and various qualities of nickel. One particularly useful feature is a nomogram designed for the calculation of Nichrome V heating elements. Well produced, and bound in a stout cloth cover to ensure serviceability, the data book is B.D.H. publication No. 37, and is available from Gaythorn Mill, Albion Street, Manchester 15.

TRADE PUBLICATIONS

SWITCHGEAR. Brush Electrical Engineering Co., Ltd., of Loughborough, has just issued two new publications, both on switchgear. One (No. 41006) gives details of type VC vertical draw-out pattern metal clad compound-filled switchgear intended mainly for use upon e.h.v. networks. The other (No. 41007) announces a switchboard for single running engine-driven alternator sets designed for use in small power and lighting installations in isolated towns and villages.

MECHANICAL SEALS. One of the very few books on the subject, Crane Packing Ltd. have issued a booklet on mechanical seals. Besides the company's own types of seals, principles of seal design are outlined.

THE WEEK *in news*

INDUSTRY COMMERCE

Italians to Make Water Valves

TO AVOID delay in the commissioning of new generating plant, B.E.A. have placed contracts in Italy for the supply of nearly 4,000 low-pressure water valves required for British power stations. The Authority decided that it was necessary to seek alternative sources of supply abroad because there is considerable congestion of orders placed with British manufacturers, intensified by the increasing demands of the Ministry of Health for valves for water services.

Not only are water valves urgently needed for this year's commissioning programme, which it is hoped will add a million more kilowatts to Britain's power capacity, but greatly increased supplies will be required for the larger additions to generating plant capacity anticipated in future years. The Italian orders have been allocated among three leading Italian manufacturers who have had considerable experience in the manufacture of large water valves for h.e. schemes.

Learning About Lighting

INTENDED to appeal especially to Electricity Board employees, the first illumination design course to be held at the re-equipped Leeds Lighting Service Bureau opens this morning at 10 a.m. Lasting altogether for four days, the course has been split in two to allow for minimum disruptions. This week, today and tomorrow, will be devoted to the elementary factors concerning good lighting, leading to the first principles of design of fittings. Next week on March 9 and 10, design will be carried further, and some of the practical applications of lighting explained.

Large Scale Cooking by Electricity

A ONE-DAY conference of the Institutional Management Association of Northern Ireland will be held in the College of Domestic Science, Belfast, on Saturday. Miss Ena M. Eaves, of the B.E.D.A., will be the principal speaker. In the morning she will discuss the importance of electricity in institutional management and emphasise that those in control should possess some electrical knowledge and understand the methods of working the electric appliances in their care. The second subject to be dealt with will be electrically operated equipment for large-scale cooking and Miss Eaves will demonstrate the lay-out of an industrial kitchen.

In the afternoon her subject will be floor maintenance equipment, and practical demonstrations will be given by Mr. P. Holden, the Irish representative of a firm of floor maintenance equipment manufacturers. On Monday, March 6, Miss Eaves addresses 100 domestic science and other specialist teachers in the College of Domestic Science, Belfast. Besides outlining types of electrical equipment suitable for schools she will demonstrate how to use the electric cooker correctly.

E.D.A. Collect "Museum" Pieces

PROGRESS in the design of domestic electrical appliances, featured at two recent E.D.A. national exhibitions, attracted so much interest that the Association are now adding to their collection of "museum" pieces. Announcing this, Mr. V. W. Dale, general manager and secretary, points out that many of these pioneer examples of electrical manufacture may be irretrievably lost to posterity unless some organised effort is made to preserve them.

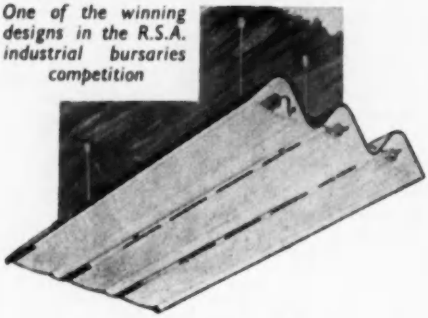
Members of the electrical industry are asked to write to E.D.A. if they have any equipment available as a gift or on loan. Manufacturers who have their own museums of electrical appliances are also requested to notify the Association.

The First Half-Century

Three weeks ago Mr. Sydney Webb contributed to *Nature* a series of photographs taken at night in Dover during a thunderstorm, in which photographs of the electric lamps along the seashore appeared with luminous dotted trails coming from them, which he attributed to the effect of lightning on the electric lamps. Appended to his letter was a much longer one from no less an eminent authority than Sir George Stokes, who, in seeking an explanation, dragged in change of potential gradients, electromagnetic waves, wireless telegraphy, and the stratification in a vacuum tube (to account for the dots), with a special explanation of how the effect might be possible without a vacuum. He concluded with a warning that people had better not stand near an arc lamp during a thunderstorm. The last number of *Nature* affords more light in a quite unexpected manner, when Mr. Wood pointed out that he was unable to convince himself that there are any effects in these pictures that cannot be explained by a moving camera.—*From our issue of March* 1, 1900.

Encouraging Good Design

FOR the first time an electric lighting fittings section has been included in the Royal Society of Arts industrial bursaries competition, the results of which have just been announced. Two young designers of electrical fittings divide a £150 bursary (donated by E.D.A.) between them. They are 28-year-old Mr. Wilfrid R. Ussner, Architectural Association School of Architecture, who wins £90, and 23-year-old Mr. Michael R. Crux, Canterbury College of Art, who receives £60.



One of the winning designs in the R.S.A. industrial bursaries competition

Held annually, the purpose of the competition is to encourage designers entering industries where design plays an important part. The bursary can be spent either in travelling abroad or obtaining further training at home. This year the work submitted in the lighting fittings section was judged by a jury consisting of Dame Caroline Haslett, chairman; Mr. A. B. Read, R.D.I.; Mr. F. R. Yerbury, and Mr. F. Winstanley.

The jury comment that preliminary work contained several promising ideas but the final designs were disappointing, although they were executed with care and attention for detail.

An exhibition of the winning designs of the whole competition (which includes several other sections) opened at the Royal Society of Arts, John Adam Street, Adelphi, W.C.2, on Monday. It continues until March 11, and the hours of opening are 10 a.m. to 5.30 p.m. on weekdays, and 10 a.m. to 12.30 p.m. on Saturdays. Admission is free. Next year it is hoped to include a section for the design of domestic electrical appliances.

Batti-Wallahs' Lunch

"PEOPLE" was the subject of a talk given at the monthly lunch of the Batti-Wallahs' Society by Mr. A. R. Cooper (Controller, Merseyside and N. Wales Division, B.E.A.) on Wednesday of last week. Assuring the company that he did not intend to point morals or draw conclusions, Mr. Cooper soon revealed himself as no mere *dilettante* in the study of human nature, as he warmed to his theme, and explained how, prompted by an intense curiosity concerning his fellow men, he had formed a small society which had jointly interviewed many famous persons to find out what had made them choose their vocations, and their hobbies.

At the other end of the social spectrum he described long hours spent in the company of tramps in an endeavour to discover what they had in common with their more worldly successful brethren, and seemed rather astonished to discover that they seemed much more carefree and less fearsome of the future. There were successful tramps, just as there were successful business men, and the common denominator of both was the ability to see oneself objectively.

The spectrum of human relationships makes a most interesting study, particularly in the ultra violet and infra red regions. It was, however, necessary to study the whole range if one were to throw upon the subject the white light of human understanding. Prior to the lunch, members paid tribute to the memory of Col. Sir Thomas Purves, for so long an eminent member of the Society.

A Good Use for Ash

AN OFFER of the British Electricity Authority to supply pulverised fuel ash from Brighton A and B generating stations, to be dumped on Waterhall Valley is to come before the Brighton Town Council today, Thursday. The Council had earlier proposed to develop the area at Waterhall Valley for recreational purposes. To do this a

Window display for Hurseal's of Regent Street won third prize in the window-dressing competition organised by the Regent Street Association. It was designed and carried out by students of the City of Canterbury College of Art

One of four Drysdale condenser circulating pumps intended for Poole power station, this pump left the Yoker works on Friday. Each pump of 48 in. bore delivers 38,000 g.p.m. at a head of 33 ft and will be driven by 575 h.p. B.T.H. motors

considerable quantity of filler material would be required. The Southern Generating Division has therefore suggested supplying ash from the Southwick power stations over the next seven years, free of cost delivered at the site. Acceptance of the offer is recommended by the Corporation Parks Committee, who point out that it will be necessary to alter the levels of water mains, at a cost of £400, but an alternative method of development would cost approximately £100,000.

Super Power Stations Advocated

ADDRESSING Newcastle Section of the Society of Chemical Industry recently, Sir Claude Gibb, chairman of C. A. Parsons and Co. Ltd., said he did not think atomic energy was going to influence future generation of energy for industrial and domestic purposes, at least until coal became so dear and scarce that present ideas of economics had to be thrown overboard.

Referring to the need for the economic use of coal in its raw state, Sir Claude suggested more electrification and the building of super power stations. Electricity could be regarded as supreme in the supply of rotary power and lighting, but gas had advantages for heating purposes. Sir Claude proposed the integration of gas, electricity, transport and coal industries.

Stud Weldings Speeds UNO Building

INSTALLATION of the floor-to-floor aluminium window frames completely enclosing the east and west walls of the new United Nations Secretariat Building, New York, was simplified and speeded up by the use of Nelson stud-welded fasteners. Stud welding is more than ten times faster than drilling and tapping for screwed studs.

The stud welding system is an electric arc process carried out with a "gun" so simple to work that all the operator has to do is to load it with a stud, place it in position and press a button. The subsequent welding cycle is completed under the control of an automatic timer ensuring a high quality weld independent of the operator's judgment. Equipment is operated from a 60-90 volt d.c. supply. In Great Britain the Nelson stud welding service is sponsored by Crompton Parkinson Ltd., Crompton House, Aldwych, London, W.C.2.

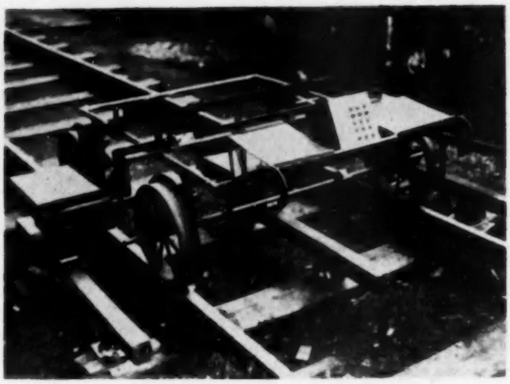
For Athletic Prowess

MR. G. LESLIE WATES chairman and joint managing director of Johnson and Phillips Ltd., presented several splendid sports trophies to successful teams at a social function held in the J. and P. works canteen, recently.

The football cup for the season 1948-49 was won by the maintenance department, runners-up being the rubber cable department. Cable estimating department won the 1949 cricket championship, with the contract department runners-up.

Mr. Austin, manager and secretary of the sports club, announced that by a recommendation of the committee, a special award to the club's relay team had been made in recognition of their performance in the past season. Earlier, old age pensioners were entertained to dinner.

Speeding the building of Uno Headquarters



For detecting faults in conductor rail alignment, London Transport have built this gauging trolley

Encourage Individual Enterprise

AN APPEAL to local business men to throw open wide the doors of their offices and factories, to interchange information, techniques and processes, and to discard restrictive outlooks was made by Mr. B. H. Dyson, works manager of Hoover Ltd., speaking at Reading last week.

Addressing local members of the Institution of Production Engineers he said it was no time for exhorting the men and women at the factory benches to greater output. There had been enough of that. What was wanted was the creation of an atmosphere in which output would go up naturally. One of the best ways to do this was to encourage individual enterprise at every level, and to arouse in the factories an enthusiasm for higher living standards based on the workers' own efforts.

B.T.H. Apprentices' Night Out

NOVEL illuminations, including a multi-coloured fountain, a large sized reproduction of the Association's badge, and a fluorescent colour-changing column were among the attractive features of the annual ball of B.T.H. (Rugby) Apprentices' Association. Held in the Masonic Hall, Rugby, among the guests present were Mr. L. J. Davies, director of research, and Mr. E. S. Little, secretary and comptroller. M.C. was Mr. R. W. Wigg, with music provided by Tom Ward's band and the programme arranged by the entertainments committee headed by Mr. C. F. R. Bradshaw and Mr. T. F. Roger.

Gauging Electric Track

LONDON TRANSPORT engineers have designed a special hand trolley for the rapid detection of discrepancies in the positions of conductor rails relative to the running rails. The four wheels of the trolley have square section tyres and flanges and the framework of light tubular steel carries two angle iron members supporting a central and two side contactor boxes. Fitted on the end of an arm from each contactor box mechanism is a double-flanged roller which rides along the conductor rail.

Vertical or lateral displacement of a roller causes the arm to pivot or slide and so make an electrical contact. Besides a bell alarm signal, a row of four lamps connected to each contactor box show whether the discrepancy is up, down, to one side or the other.

Relieving Rush Hour Queues

IN an effort to relieve passenger congestion at peak periods Glasgow Corporation are to experiment with a single deck trolley bus of Continental design. Accommodating about 28 seated passengers and 40 standing, passengers will enter the vehicle by a large platform at the rear and pay their fare to the conductor before passing inside.

At a meeting of the transport committee last week when the idea was approved, it was said that objections to the number of standing passengers from the conductor's point of view would not arise as he would not be moving among them to collect fares. As they approached their destination passengers would filter through to a front exit. Both doors would be electrically controlled.

AT THE B.T.H. BALL

Standing (left to right): C. Grad, H. W. Malin, J. G. Pluckrose, E. S. Little, D. Gibbons, I. Badham, R. W. Wigg, T. F. Roger, and G. Richards. Seated (left to right): R. G. A. Dimmick, H. Dreghorn, M. D. H. Whitehead, C. F. R. Bradshaw, F. Szekely, P. G. Herringshaw, G. S. C. Lucas and G. Maxfield

Recording Van for Radio Luxembourg

ANXIOUS to improve their outside broadcasting facilities, Radio Luxembourg have purchased a broadcast recording van equipped for recording broadcast programmes on magnetic tape.

The interior of the van, built by E.M.I. Factories Ltd., is divided into two separate compartments. The forward one contains the recording equipment and operator's position, the rear compartment housing the cables, cable entries, drums, etc. Special translucent roof windows allow the operator to work in natural light during the daytime, and the interior of the van is heated by an H.M.V. Cavendish convector heater.

Main items in the equipment are two of the well-known E.M.I. magnetic tape recorders and a disc recorder and replay desk. The control panel comprises a five-channel microphone pre-amplifier with individual fading, programme meter and phone or loudspeaker monitoring facilities. It can be lifted out and carried to the recording site when the distances involved make it undesirable to run long microphone cables.

Two high quality loudspeaker units are provided for remote replay purposes on the recording site, and power supply is taken on site from suitable a.c. supplies, but standby lighting may be operated from the van's electrical system.

Neatly laid-out interior of the broadcasting recording van supplied to Radio Luxembourg

Cases in Court

Sale of Chokes

IN the King's Bench Division last week, Mr. Justice Lloyd-Jacob delivered his judgment in an action by Paramount Supplies Manchester Ltd. against Thorn Electrical Industries Ltd., claiming £3,339, being the price of goods sold delivered. They also claimed damages for alleged breach of contract and a declaration that they were entitled to an indemnity against any claim made by the Coil Winding Co. Ltd.

The plaintiff's case was to render a contract on March 1947 for the defendants to a firm known as Paramount Products, this company contracted to supply 25,000 Paramount tapless chokes at 21s. 3d. each and another 15,000 tapped chokes at 23s. 3d. each, at the rate of 1,000 a week.

At the end of 1947, it was alleged that Paramount Products, was transferred to the plaintiffs with the consent of the defendants. Plaintiffs had delivered 24,000 chokes to the defendants which had been accepted and paid for. In 1948 it was said that chokes to the value of £3,339 had been delivered and accepted by the defendants, but not paid for. The plaintiffs now claimed the sum with interest and damages for loss of profits and a declaration that plaintiffs were entitled to be indemnified against any claim made against them by the Midland Coil Winding Co. Ltd.

The defendants alleged that the deliveries were made by the plaintiffs as agents of Paramount Products. They further alleged that the contract had been broken. They also said the Midland Co. were interested in the matter.

Defendants counter claimed for damages and alleged overcharges, which was denied by the plaintiffs.

After several days' hearing, his lordship dismissed the claim with costs and dismissed the counter claim with such costs as were applicable.

Action Against Southern Board

IN the King's Bench Division on Thursday, the Lord Chief Justice, Lord Goddard, had before him an action by Mrs. M. Quemby, a widow, of Uxbridge, to recover from the Southern Electricity Board and manager on behalf of herself and her two children, for death of her husband Mr. C. A. E. Quemby, who died as a result of an accident whilst on motor cycle duty at Twickenham in January, 1948.

Plaintiff's case was that there was a patch of ice on the road which caused the accident.

It was alleged that the defendants' electric cables were relayed in 1942 in the bank which separated the ditch from the roadway and that water had escaped from the ditch into the roadway and had caused a nuisance.

The defendants denied negligence or nuisance.

Eventually the case was settled by an award of £1,850 and costs to the plaintiff.

His lordship said it was a proper case for compromise, because there were difficult questions of liability to be decided.

Electric Supply News

Belfast

The Corporation Electricity Committee has recommended that an application be made to the Ministry of Commerce for sanction to borrow £390,000 for distribution equipment for the year up to March 31. The electrical engineer and manager (Mr. W. J. Girvan) in a report stated that the rate at which applications had been made for new supplies both for industrial and domestic, was greater than anticipated, and he did not expect any appreciable reduction in the volume of business during the coming financial year. There was a total over expenditure at December 25, 1949, of £37,483, made up by: mains and services £92,277; cooker circuits for hire and hire purchase £5,513, and domestic equipment £8,018. A further sum of £422,300 would be required to carry out the works in hand to March 31 and to provide for the over expenditure.

Brighton

The Education Committee has had under consideration the effect of the decision of the South Eastern Electricity Board to increase the unit charges for electricity consumed in heating certain of the Council's schools, payment for which has previously been based on preferential tariffs agreed upon with the Corporation electricity undertaking. The Education Officer has reported that the revised tariffs entail increases in unit charges varying between 47% to 120% on the old charges. Under the new tariff, for off-peak supplies for space heating there would be a basic charge of 0·45d. p.u. plus a variable charge related to the average fuel cost. Based on 1949 costs, the resultant charge would be 0·67d. p.u. For space heating supplies not time-switch controlled, for both industrial and domestic consumers the unit charge is 0·75d. p.u. In notifying the Corporation of the increased charges, the Board has stated that these are fixed in relation to the increases in fuel prices, but the Education Officer is of the opinion that the increases are out of all proportion to any comparable rise in heating costs by other means.

The Corporation has six schools with electric heating, but at two only is the thermal storage system, with low pressure hot-water radiators, employed. In regard to the Patcham Secondary and Primary Schools, where this method is used, the system could be changed over to solid fuel firing, thereby saving £550 annually, it has been shown. The Committee recommends that representations be made to the Board for a substantial revision of the increased charges, and that a deputation should discuss the matter.

Durham

The Rural Council has been informed that the supply of electricity to the new village at North Bowburn would be considerably delayed. The original arrangement had been for a temporary supply from Bowburn Colliery, until a new substation had been built. Owing to recent alterations in the network and extra commitments at the colliery this was not possible now. It might be nine months before the North-Eastern Electricity Board could build a substation.

Eastern Board

In the month of January this year the Eastern Electricity Board connected 5,298 new consumers, compared with 4,168 during the corresponding period of 1949. Units purchased for re-sale over the same period amounted to 436 million in 1950 and 387 million in 1949. A further 6,237 kVA of substation capacity was also added this year. Turnover in sales and contracting work also shows a satisfactory increase, the sum of £323,330 being involved during January last, as against £243,380 for the same period in 1949.

LIGHTING SCHEMES

Aberdeen.—The Watching and Lighting Committee has recommended that a sum not exceeding £1,000 be granted for experimental fluorescent lighting in a section of King Street before installing it in Union Street, when the supply in the latter road is changed from d.c. to a.c.

Ballymena.—The Borough Council is to consider a scheme for the lighting of the streets by electricity in place of gas.

Boldon.—The U.D.C. is being recommended to carry out a street lighting improvement scheme to cost £15,016. During the current year it is intended to install lighting at Boldon Colliery at a cost of £5,850 and application has been made to the Ministry to carry out the scheme.

Bridlington.—The Highways Committee is to carry out experiments with mercury vapour, tungsten and sodium lighting on the sea front and in some streets.

Brighton.—On the illuminations scheme for 1950, the Street Lighting Sub-Committee consider the suggestion for lighting east of the Palace Pier would cost approximately £5,000, and at this juncture they think it best to concentrate mainly upon the area between the Aquarium and the West Pier. The Mazda colour-changing fountain is to be restored, the B.T.H. Co. providing £500 and the Council £310 to cover the cost.

Douglas (I.o.M.)—The T.C. has agreed to provision being made in next year's estimates for the expenditure of £3,905 to cover the cost of extended illuminations for the 1950 season.

Edmonton.—An amended estimate of £1,834 for street lighting on the Council's Cuckoo Hall estate has been approved.

Hampstead.—Street lighting in Temple Fortune Lane, Hampstead Garden Suburb, is to be improved at an estimated cost of £760.

Company Activities

British Automatic Refrigerators, Ltd.

The capital has been increased from £40,000 to £200,000 by the creation of 100,000 6% £1 Cumulative Redeemable Preference shares and 240,000 5s. Ordinary shares. The chairman and managing director, Sir Leonard Dyer, states there is no question of the shares being marketed in the reasonably near future.

British Industrial Plastics

This was not the time to make an issue of Ordinary shares, Mr. K. M. Chance, chairman, stated at the meeting last Friday, and the directors had, therefore, carried a portion of the heavy capital commitments by the issue to the British Shareholders' Trust of £250,000 4½% Unsecured Notes at 98%, less 2% for brokerage and expenses. This will bring in £240,000, making the total surplus current assets £640,000. The Notes are repayable from 6 to 10 years from date of issue, by when, Mr. Chance hopes, it may be possible to make an issue of Ordinary shares to provide more capital and redeem the Notes. Referring to increasing production, he spoke of the erection of the building for the new factory being well under way, This factory will double their capacity for the production of highest grade Beetle and melamine moulding powders. It was doubtful if it would be in full production by the end of next year.

J. & E. Hall Ltd.

For the year ended September 30, the trading profit was £452,028 (*£293,462*), after allowing for depreciation £42,198 (*£38,182*), extra depreciation equal to the gross amount of initial allowances granted under tax legislation £16,528 (*£7,382*), directors' fees and management remuneration £32,541 (*£29,296*), past director's pension £500 (*same*), audit fee £1,332 (*£1,316*), and provision for diminution in value of stock and work in progress £107,000 (*£65,000*). Net profit amounted to £113,831 (*£90,051*), including income from investments £1,783 (*£2,024*), and after charging bank interest £9,980 (*£5,435*), income tax £252,000 (*£150,000*), and profits tax £78,000 (*£50,000*). To Preference dividends £3,960 (*same*), Ordinary interim 2½% £9,240, and final 7½%, £27,720 (*both same*), leaving £284,893 (*£211,982*) carried forward.

London Aluminium Co.

Preliminary report shows a trading profit for 1949 of £148,702 (*£303,045*), with a net profit, including interest and dividends, subject to taxation, of £112,376 (*£270,443*). With £30,149 (*£19,542*) brought in, there is £142,525 (*£291,567*) available. A final dividend of 10% is recommended as against 70% last year, making a total of 40% (*100%*). Taxation takes £67,860 (*£165,856*). Preference dividend absorbs £7,562 and the interim Ordinary dividend £26,400 (*both same*). Final dividend takes £8,800, leaving £31,903 carried forward.

Mather & Platt Ltd.

Preliminary details showed net profit for the year ended December 31 last, of £288,267 (*£137,393*), after transferring £200,000 (*£250,000*) to stock in trade contingency reserve. Final Ordinary dividend of 7%, making 11% (*both same*).

Negretti & Zambra

For the year to September 30 last, trading profit was £174,572 (*£165,137*), plus investment dividends £1,477 (*£2,228*), rents £2,687 (*£138*). To interest £401 (*£8,583*), directors' management remuneration £12,443 (*£11,851*), directors' fee £250 (*same*), depreciation £5,994 (*£4,818*), leaving £159,648 (*£137,001*). Profits tax takes £20,304 (*£20,900*), income tax £59,303 (*£68,381*), Preference dividend £4,812 (*£1,375*), Ordinary interim £3,850 (*same*), final Ordinary 10% £9,625 (*same*), leaving £93,856 (*£32,102*) carried forward.

Palestine Electric Corporation Ltd.

At last Friday's meeting, the resolutions authorising the one-for-six capital bonus issue, and amending the articles, were approved.

Parsons Engineering

Trading loss for the year to October 31 last amounted to £10,961 (*£10,443*). Directors' remuneration absorbs £2,000 (£2,100), bank charges and interest £146 (*£399*), registrars' fees £295 (*£316*), audit fee £150 (*same*), depreciation of plant, etc., £1,371 (*£1,441*), amortisation of works on leasehold land £2,260 (*nil*), stores and work in progress depreciation £8,154 (*nil*), making the net loss £25,337 (*£14,849*), increasing the debit carried forward to £33,715 (*£8,378*). The chairman, Mr. H. Parsons, states the second half of the year resulted in largely increased gross profit, and for the whole year business obtained showed an increase of approximately 70% on the previous year.

John Shaw Bros. (Wolverhampton) Ltd.

Treasury consent to the proposed 100% capital bonus, involving the issue of 669,993 5s. Ordinary shares on a one-for-one basis.

Dividends Declared

Bruce Peebles and Co.—Dividend of 10% (*same*)

Clarke Chapman and Co.—Ordinary dividend of 12½% (*same*). Net profit for 1949 £172,098 (*£156,270*).

General Engineering Co. (*Radcliffe*).—Dividend of 20% (*same*).

Morphy-Richards Ltd.—Interim dividend of 15% (60%) on capital increased by 300% bonus issue.

Ransome and Marles Bearing Co.—Interim dividend of 7½%.

Commercial Information

CONTRACTS OPEN

HOME

Mar. 4.—Hepton R.D.C. Pumping plant for Heptonstall water extension. Two sets of pumps, electric motors with automatic control starting gear, etc. Council's Consulting Engineer, A. Brooksbank, 14 The Exchange, Bradford.

Mar. 4.—Irlam U.D.C. Twelve months' supply of electric lamps. Engineer and Surveyor, Council Offices, Irlam.

Mar. 4.—Durham C.C. Electrical installation to eight houses and office at Fir Tree site Wingate. Police Authority. County Architect's Office, Court Lane, Durham.

Mar. 6.—Tayport T.C. Electrical work for 18 houses to be erected at Cowgate. Burgh Surveyor's Office, Tayport.

Mar. 8.—Mendip Hospital Management Committee. Twelve months' supply of electrical accessories. M. L. Lowe, Secretary, Mendip Hospital Management Committee, Wells, Somerset.

Mar. 9.—Macclesfield T.C. Installation of electric lighting and power at Museum, West Park. Borough Architect, 3 Jordangate, Macclesfield. Deposit £1 1s.

Mar. 9.—Port of Bristol Authority. Twelve months' supply of electric lamps and sundries. Central Purchasing Dept., 2 Upper York St., St. Paul's, Bristol 2.

Mar. 9.—Manchester T.C. Electrical installations for Hazelcroft, Congleton Rd., Alderley Edge. City Architect, Town Hall, Manchester. Deposit £1 1s.

Mar. 10.—Edinburgh T.C. Supply of 50 floodlighting fittings. Engineer and Manager, Lighting and Cleansing Dept., 329 High St., Edinburgh 1.

Mar. 10.—Manchester T.C. Electrical installation at Old Hall Drive Secondary School, Gorton. City Architect, Town Hall. Deposit £1 1s.

Mar. 10.—Belfast.—Electrical installation in the new nurses' home. J. R. W. Murland, Consulting Engineer, 13 Wellington Place, Belfast. Deposit £3 3s.

Mar. 11.—Keighley T.C. Small electrically driven "booster" pumping plant for waterworks department. G. E. V. Boldry, Waterworks Engineer, Martins Bank Chambers, Keighley.

Mar. 11.—Hyde T.C. Erection of 75 class B street lighting units at Harbour Farm housing estate, Newton, Hyde. Borough Engineer, Municipal Buildings, Greenfield St., Hyde.

Mar. 11.—Barry T.C. Twelve months' supply of electrical goods. J. Ll. Davies, Borough Engineer, Town Hall, Barry.

Mar. 13.—Slough T.C. (*a*) Provision and erection of 42 pre-cast concrete columns and 42 mercury vapour lanterns for Stoke Poges Lane (East) estate. (*b*) One motor tower waggon for street lighting maintenance. Borough Engineer, Town Hall, Slough. (See our Feb. 23 issue).

Mar. 13.—Willenhall U.D.C. Twelve months' supply of electric lamps. Engineer and Surveyor, Town Hall, Willenhall.

March 14.—Berwick-on-Tweed T.C.—Work involving installation of 1,556 lighting points and 200 5-amp socket outlets to living rooms in pre-war council houses and flats. Borough surveyor, Municipal Buildings, Berwick-on-Tweed.

Mar. 14.—East Lothian Water Board. Electrically driven surface pumps. Two pumps at 500,000 gal per day each and two at 1,500,000 gal per day each, for Whiteadder Valley pumping station, near Priestlaw. G. H. Hill and Sons, Civil Engineers, 51 Mosley St., Manchester.

Mar. 15.—Stepney T.C. Installation of three electrically operated passenger lifts in flats being erected at Bancroft Rd. Borough Engineer and Surveyor, London Fruit Exchange, Duval St., Spitalfields, E.1.

Mar. 16.—Kidsgrove U.D.C. Mercury discharge street lighting) (lamps and concrete columns). Contract No. 1: (*a*) Winchester-Preston trunk road (A.34 and A.5011) (Newcastle Rd.); (*b*) Stoke-on-Trent-Middlewich-Delamere trunk road (A.50) (Liverpool Rd.) Contract No. 2: Congleton Rd., Butt Lane (A.34). Contract No. 3: Ashenough estate. Contract No. 4: Crown Bank estate. Contract No. 5: Galleys Bank estate. M. R. Gethin, Engineer and Surveyor, Town Hall, Kidsgrove.

Mar. 18.—Belfast T.C. 33 kV, 1,000 MVA switchgear and accessories to form extension to existing Reyrolle switchgear and modifications to increase rating of present gear from 750 MVA to 1,000 MVA. Merz and McLellan, Carliol House, Newcastle-on-Tyne 1. Deposit £5 5s.

Mar. 18.—Hemsworth R.D.C. Wiring installation in 723 houses on various estates. Council's Engineer and Surveyor, Mr. S. Price, Brierley Hall, Brierley, near Barnsley.

Mar. 20.—Luton T.C. Installation of electrical services, wiring and equipment for Farley county primary school. Borough Engineer, Town Hall, Luton. Deposit £2 2s.

Mar. 22.—Darlington T.C.—Internal wiring of filter house and chemical house at Corporation waterworks, Coniscliffe Road, Darlington. Borough Surveyor, Town Hall, Darlington. Deposit £2 2s. (Advertised in this Issue).

Mar. 24.—Edinburgh T.C. Electric lighting and power installations in 212 houses and 15 shops at Inch housing area. City Architect, City Chambers, Edinburgh.

No date stated.—Longbenton U.D.C. Electrical installation in 72 houses on various sites. Surveyor, A. E. Sweetman, Council Offices, Forest Hall.

No date stated.—Newcastle-on-Tyne T.C. Six months' repair and maintenance work for electrical installations in council houses. G. Kenyon, City Architect, 18 Cloth Market, Newcastle-on-Tyne.

No date stated.—Seaton Valley U.D.C. Electricity installation in 24 houses on Blyth St. estate, Seaton Delaval. T. W. Burgess, Council Surveyor.

No date stated.—Redcar T.C. Supply of public address system for use in connection with beach patrol service. Town Clerk, H. Caldwell, Municipal Buildings, Redcar.

OVERSEAS

*Details of items marked * may be obtained on application to Room 1076, Board of Trade, Thames House, North Millbank, London S.W.1, quoting reference number.*

Mar. 6.—Uruguay. Micro-telephones and induction coils. Direction General de Comunicaciones, Montevideo. B.o.T. (Ref. CRE (IB) 43735/50).*

Mar. 9.—Greece. Telephone apparatus, including cables and terminal boxes. Greek State Railways, Athens. B.o.T. (Ref. CRE (IB) 43578/50).*

Mar. 15.—Southern Rhodesia. Supply and installation of a public address and radio diffusion system. Town Electrical Engineer, P.O. Box 121, Umtali, Southern Rhodesia.

Mar. 15.—India. Year's supply of various types of cables; estimated value Rs 1,700,000. Director-General of Industries and Supplies, New Delhi. B.o.T. (Ref. CRE (IB) 43576/50).*

Mar. 16.—Morocco. One 950 kW and two 2,000 kW generator sets. M. l'Ingenieur en Chef des Travaux Publics d'Etat, Administration Internationale de Tangier. B.o.T. (Ref. CRE (IB) 40516/50).*

Mar. 16.—South Africa. Stranded, hard-drawn, bare copper conductor: 20 tons of 0·1 (7/0·136), 10 tons of 0·05 (3/0·147) and 25 tons of 0·025 (3/0·104). Twenty miles of 3/0·036 (0·003) varnished cambric insulated annealed copper conductor, and 60 miles of 7/0·044 (0·01) varnished cambric-insulated hard-drawn copper conductor. City Engineer, Electricity House, Strand St., Cape Town. B.o.T. (Ref. CRE (IB) 42732/50).*

Mar. 16.—Tangiers. Three diesel-electric generating sets; one 950 kW, two 2 000 kW. Monsieur l'Ingenieur en Chef des Travaux Public d'Etat, Administration Internationale de la Zone de Tangiers.

Mar. 20.—South Africa. 11 MVA 20·5/6·6 kV transformers. Room 19, Head Office, Electricity Dept., President St., West, Johannesburg. Deposit £3 3s.

Mar. 24.—Uruguay. Fifteen equipments for step-down transformer substations, 3-phase, 50 c/s per second at 6,300 V transformed to 220 V. Usinas Electricas y Telefonos del Estado. B.o.T. (Ref. CRE (IB 42245/50).*

Mar. 30.—Australia. One outdoor, oil cooled 3,000 kVA transformer, 50 c/s, 3-phase. City Electric Light Co., Brisbane. B.o.T. (Ref. CRE (IB) 44273/50).*

Mar. 31.—Australia. Supply and delivery of four 11,000 V, 3-phase, 600-amp, double busbar, compound filled, metalclad, indoor type switchboards. Town clerk, Brisbane City Council, City Hall, Brisbane. B.o.T. (CRE (IB) 30010/50).*

Apr. 3—S. Africa.—Supply, delivery and erection of: Contract A, steam raising plant, coal and ash handling plant, valves, piping, and water tanks. Contract B, two 750 kW passenger steam or turbine driven generating sets, one sea-water distilling plant for 200 tons daily output, circulating water pumps, and piping, main and auxiliary switchgear, transformer, etc. Council's consulting engineer, George Drewelt, Manlin House (Floor 1), 17 Harrison St., P.O. Box 35, Johannesburg.

Apr. 5.—Australia. Supply of 28 only electrically operated overhead travelling cranes. Specification 49-50/249. Agent-General for Victoria, Strand, W.C.2.

Apr. 11.—New South Wales.—Supply of electrically driven refrigeration plant for production of dry ice and chilled water for concrete mixing. Metropolitan Water Sewerage and Drainage Board, 341 Pitt St., Sydney.

Apr. 14. — Uruguay. — Supply and installation of transmission lines and equipment for first stage of "Western circuit" of National Electric Power Network. Equipment includes three 25,000 kVA transformers, one 2,000 kVA, three 5,000 kVA and three 1,500 kVA. Administracion General de la Usinas Electricas y los Telefonos del Estado. B.o.T. (Ref. CRE (IB) 30179/50).*

Apr. 15.—Greece. Telecommunication, equipment and materials. Ministry of Posts, Telegraphs and Telephones, Athens. B.o.T. (Ref. CRE (IB) 43996/50).*

Apr. 18.—Egypt.—Erection of Amaria electric pumping station near existing pumping station. Work comprises erection of pump-house building, and supply of three electric-driven pumping units (1-1/2 m3/sec) at a static head of 2.8 m complete with electric transformers, switchgear and station auxiliaries, and 3-phase armoured cable line at about 1,800 m feeding the pumping station with electric current at 10.5 kV from Cairo North power station, to be erected by the Government. Director - General, Mechanical and Electrical Dept., Ministry of Public Works, Cairo, or from the Chief Inspecting Engineer of the Egyptian Government in London.

Your Queries — Answered

Plastic S.E.S. lampholders, makers of? G.G.—Victor H. Iddon, Ltd., of Harper Rd., Wythenshaw, Manchester, respond as manufacturers of these, and Barries Electrical Agencies of King St., Brighton, offer to supply a batten type holder. (17676)

"B.N.B." contactors, makers of? L.E.B.—We presume our enquirer refers to E.N.B. which are made by E. N. Bray, Ltd., Whipps Cross Works, Wood St., Walthamstow, E. (17714)

Broads lighting columns, address for? T.E.—The lighting column interest of Broads Mfg., Co., Ltd., has been acquired by Tarslag Ltd., of Wolverhampton. (17739)

"Aquator" immersion heaters, makers of? T.E.—H. Johns, 217 Coventry Rd., Small Heath, Birmingham 11. (17719)

"Darn-a-Lite" illuminated mushroom for darning, makers of? T.E.—Radio Electric Development (Crewe), Ltd., Excelsior Works, Walthall St., Crewe. (17723)

Polisher, hand domestic for furniture, etc., makers of? T.E.—Electrix Ltd., Sterling Works, Dagenham. (17728)

"Flexo" couplings, makers of? T.E.—Reliance Electric Wire Co.,Ltd.,Fingal Works, Staffa Road, Leyton, E.10. (17733)

The above are selected from questions we have answered this week. If you have a query, send it to us.

Apr. 18.—**New Zealand.**—Four 4·44 MVA transformer banks and spare unit. State Hydro-electric dept. B.o.T. (Ref. CRE (IB) 31054/49).*

Apr. 27.—**Uruguay.**—6,000 6 kV and 17,000 15 kV porcelain high tension insulators. Usinas Electricas y Telefonos del Estado. B.o.T. (Ref. CRE (IB) 34074/49).*

May 1.—**South Africa.**—Supply, delivery and erection of plant and materials for electricity supply undertaking, Contract A, comprising 40 kW and 15 kW oil engine-driven generating sets, switchgear, transformers, cables, complete low-tension distribution network and house service connections. Town clerk, Port St. Johns. Deposit £3 3s.

May 9.—**New Zealand.**—One 25-ton electric o.h. travelling crane for Gisborne substation. New Zealand State H.E. Dept.

CONTRACTS PLACED

Bideford T.C. Street lighting scheme. South Western Board, £3,044 (recommended).

Bradford T.C. Electrical installations at Ravenscliffe infants' school. J. Carter and Sons (Bradford) Ltd., £2,019.

Hull T.C. Electrical installations to 308 houses, Bilton Grange, in three separate contracts: 118 houses, W. Marlow; 96 and 94 houses, Humber Electrical Engineering Co. Ltd.

PRICES OF CABLE METALS AND OTHER MATERIALS
(at Tuesday night)

	£	s	d	New York price
COPPER, electrolytic	153	0	0	£140 0 0
Delivered in 2nd and 3rd month after order ...	155	10	0	—
Delivered in 4th, 5th and 6th month after order	158	0	0	—
LEAD, good soft pig (foreign)	97	0	0	96 0 0
" " " "English" quality	98	10	0	—
Delivered in 2nd and 3rd month after order, plus	2	0	0	—
TIN (99-99·75%) ... ... (Cash) ...	599½-600			—
" (3 months)	583½-584			—
ALUMINIUM, commercial purity (del.)	112	0	0	—
ZINC	85	10	0	78 0 0
ARMOURING:				
Galv. Steel Wire (0·104 in.)	39	10	0	—
Mild Steel Tape (0·04 in.)	26	0	0	—

GAZETTE ANNOUNCEMENTS

COMPANIES ACTS

Mayfield Electrics Ltd.—Resolution for voluntary winding up passed at meeting on February 16. Mr. H. P. Carter, 8 Breams Buildings, E.C.4, appointed liquidator.

W. H. Wright and Co., Ltd.—Radio and electrical contractors, 13 Exhibition Road, S.W.7. Mr. E. G. Braithwaite, 11 Exhibition Road, S.W.7, appointed liquidator at meeting on February 10.

Senior Lighting Co. Ltd.—Meeting of creditors at Grosvenor Hotel, 101 Buckingham Palace Road, S.W.1 on March 17 at 11 a.m., to receive statement of affairs, and to appoint liquidator. Proxies to be used at meeting must be lodged with the company at Senior Works, Church Street, Staines, before 4 p.m., March 16. Statements of account should be sent to A. A. Henley and Co., 19-20 Grosvenor Place, S.W.1.

Partnership Dissolved

Chad Electrical Co.—Partnership dissolved between Charles William Hisgrove and Arthur Alfred Davis, carrying on business as electrical engineers and retailers at 195 Old Oak Road, Acton, London, on retirement of A. A. Davis. Debts will be paid by C. H. Hisgrove, who is carrying on business.

COMPANIES WINDING UP

Stamford Electrical Ltd., Park Works, Barnack Road, Stamford, Lincs.

First meeting of creditors was held at Bankruptcy Buildings, Carey St., London W.C.2, on February 22. The company was incorporated as a private concern in October, 1933, with a nominal capital of £20,000 which was increased in 1947 to £40,000. The issued and paid up capital was returned at £8,395.

Stock of the company intended for the Indian market accumulated when India imposed restrictions on the import of electrical gear. In 1946, on sales on £71,472, there was a gross profit of £19,463 with a net loss of £7,183; and in the following year on sales of £117,480 a net loss of £24,650. For the last year of trading, 1948, on sales of £182,828 the company earned a net profit of £11,198.

In May, 1949, when a receiver was appointed by the debenture holders, there were unsecured liabilities of £121,997. Assets were estimated at £97,430 and after allowing £10,300 for fully secured creditors; £2,679 for preferential claims and £40,287 due to the debenture holders, there were net assets of £40,843.

TRADE NOTES

Change of Address.—The head office and reproducer sales dept. of R.C.A. Photophone Ltd., has been transferred to 36 Woodstock Grove, London W.12. Telephone: Shepherds Bush 1200.

Stockists.—Channel Conduits (1949) Ltd., announce that the British Central Electrical Co., Ltd. 6/8 Rosebery Avenue, E.C.1, (TER. 2525), are London wholesalers stocking a complete range of Channel conduit and Channel conduit fittings.

The Metropolitan Vickers Electrical Co., Ltd., have officially appointed the Johnson Engineering Co. as stockists and distributors of their complete range of f.h.p. motors, and are now building up comprehensive stocks at 319 Kennington Rd., London S.E.11, from which users, immediate requirements can be supplied at similar terms to those previously obtained direct from the factory. "Metrovick" spare parts are also available, and rapid repairs and rewinds can be carried out

Canadian Branch.—Wolf Electric Tools Ltd., announce the opening of a Canadian branch at 2271 Bloor St. West, Toronto 9, where stocks of "Wolf" tools, accessories and spare parts are available.

Annual Holidays. — Telcon Works, Greenwich, and Frequency Works, Farnborough, Kent, of the Telegraph Construction and Maintenance Co., Ltd., will be closed for the annual holiday from July 29 to August 7, inclusive.

BUSINESS PROSPECTS

HOME

Barnes T.C. Erection of 16 flats at Ranelagh Gardens, Rocks Lane, S.W.13. Borough Engineer and Surveyor, Municipal Offices, Sheen Lane, S.W.14.

Bellingham R.D.C. Erection of 28 houses. Names of electrical contractors to be forwarded to W. Dixon and Sons, Council's Architects, 1 Collingwood St., Newcastle-on-Tyne 1.

Birmingham T.C. First stage in construction of new technical commercial and art colleges at Gosta Green. H. V. Ashley and Winton Newman, Architects, 3 Verulam Buildings, Grays Inn, W.C.1.

Boldon. Durham C.C. is to build an old people's hostel at Boldon. County Architect, Court Lane, Durham.

Chesterton R.D.C. Erection of 4 houses at Boxworth, 12 at Cottenham, 8 at Longstanton, 8 at Oakington and 10 at Little Shelford. Architect, H. Jackson, 93 Hurtington Grove, Cambridge.

Dudley T.C. Recommended to invite tenders for installation of electricity in 1,500 council houses.

Eastbourne T.C. Erection of one block of 12 flats in Bourne St., and five pairs of houses on Section 18 of Chatfield Davis estate, Hampdon Park. Borough Engineer, 2-4 Saffron Rd., Eastbourne.

East Sussex C.C. Adaptation of Grey Friars, Winchelsea, and Park House, Hove Park Gardens, Hove, into homes for the aged. County Architect, J. Catchpole, County Hall, Lewes.

Guildford R.D.C. Erection of 30 dwellings at Rickford Hill Worplesdon, and 16 dwellings, at Meadowlands', The Street, West Clandon. Engineer and Surveyor, Millmead House, Guildford.

Horncastle U.D.C. Erection of 40 houses between Boston Rd. and Mareham Rd. Architects, Wm. Saunders and Partners, 24 Castle Gate, Newark-on-Trent.

Jarrow-on-Tyne T.C. Construction of a block of flats (84 dwellings) on the Albion St. Site. Borough Engineer, H. W. T. Perkins, Town Hall, Jarrow-on-Tyne.

Maryport. Bata Shoe Co. are to carry out extensions covering 47,000 sq. ft. on land adjoining the Solway Estate, Maryport.

Manchester T.C. Conversion of Warford House and Entrance Hall, Mobberley, and extensions to Remand Home at Alder House, Whalley Range, Manchester for children's committee. City Architect, Town Hall.

Metropolitan Water Board. Works Committee proposes to replace old pumping equipment at new River Head pumping station by installation of two electrically driven centrifugal pumping sets, working on purchased electric power. Estimated cost of the proposed works, inclusive of control gear, switchgear, cables, pipes, and connections, valves and Venturi meter, is £10,500.

Mexborough U.D.C. Erection of 20 flats at New St. Clerk of the Council, Council Offices, Adwick Rd., Mexborough.

Middlesbrough E.C. E. Griffiths and Son, Bromborough, Cheshire, appointed heating and lighting consultants for new Stainsby secondary schools. Architects, S. W. Milburn and Partners, 9 Esplanade, Sunderland.

Pittenweem T.C. All trades for erection of 10 houses at East Braes. L. A. Rolland, Architect, The Albion House, Shorehead, Leven, Fife.

Pontefract T.C.—Erection of 14 pairs of houses on Chequerfield estate. Borough Engineer, Municipal Offices, Pontefract.

Seaham. Improvements are to be carried out to the operating theatre at Seaham Hall Sanatorium for Newcastle Regional Hospital Board. Architects, S. W. Milburn and Partners, 9 Esplanade, Sunderland.

Surrey C.C. Erection of 40 houses with 12 garages and traffic centre depot at Burpham. County Architect, County Hall, Kingston-on-Thames.

Tadcaster R.D.C. Erection of 10 houses at Scholes, 20 at Micklefield, 6 at Swillington, and 8 at Church Fenton. Council's Architects, Anthony Steel and Owen, 89 Albion St., Leeds 1.

Thedwastre R.D.C. Erection of 12 houses at Woolpit. Hunt and Coates, Council's Architects, 84 Guildhall St., Bury St. Edmunds.

Wakefield R.D.C. Erection of 22 houses at Crofton, 28 at Crigglestone and 20 at Sharlston. Council's Surveyor, Mr. E. Massie, Council Offices Wakefield, Yorks.

Walsall T.C. Erection of (1) 47 houses and (2) 33 houses at Little Bloxwich North. M. E. Haberslon, Borough Engineer and Surveyor, Council House, Walsall.

Weardale R.D.C. Construction of 12 houses at St. John's Chapel. Architect, J. J. Eltringham, Derwent St., Blackhill.

Withernsea U.D.C. Erection of 28 houses at Highfield estate, Withernsea, Council's Architects, Anthony Steel and Owen, Astragal House, 199 Anlaby Rd., Kingston-upon-Hull.

Wycombe R.D.C. Erection of 30 houses and bungalows at Bourne End. J. M. Smith, architect and surveyor to the Council, 100 Easton St., High Wycombe.

OVERSEAS

India.—Probable requirements of the Government of Saurashtra for electrical apparatus covering the next two to three years includes the following: 1,000 to 5,000 kVA 11 kV/66 kV single phase step-up outdoor type transformers with all outdoor type control gears; 200 to 1,000 kVA 3·3 kV/33 kV, 3 phase, step-up transformers; 100 to 500 kVA 33 kV/11 kV, 3 phase step-down transformers; 100 to 500 kVA 33 kV/400 V, 3 phase step-down transformers; 200 to 1,000 kVA 33 kV/3·3 kV, 3 phase step-down transformers; 5 to 20 kVA 33 kV/400 V, 3 phase step-down transformers (outdoor pole mounting); 33 kV 11 kV 3·3 kV, substation controlling gear; 33 kV 11 kV 3·3 kV, suspension disc and pin and shackle type insulators; 0·04 to 0·075 A.C.S.R. or stranded copper conductors. Switchgear for substations: mercury arc rectifiers or rotary convertors 33 kV to 400 V d.c. with step-down transformers 250 and 500 kW capacity; turbo-alternator sets 4,000 kW 11 kV 3 phase 50 frequency; with control gear; boiler plant for above turbo steam pressure not below 400 lb/sq in.; energy kVh meters, a.c. single phase and 3 phase, 3 wire and 4 wire; energy meter 220 and 440 V d.c., kWh meter. Communications should be addressed to: Minister for Industries and Commerce, United State of Saurashtra, Rajkot, India.

MEETINGS TO NOTE

THURSDAY, MARCH 2

I.E.E. (London meeting).—"Some Electrical Methods of Measuring Mechanical Quantities," F. J. Woodcock. Institution Lecture Theatre, Savoy Place, W.C.2.—5.30 p.m.

A.S.E.E. (S. London branch).—"Motor Control Gear," R. F. Mathieson. Cafe Royal, Croydon.—8 p.m.

I.E.E. (Bristol students' section).—Joint brains trust with Inst. Mech. Engrs. (Graduate section). Electricity House, Bristol.—7 p.m.

INST. RADIO ENGRS. (Scottish section).—"The Limitations of the Loud Speaker," P. J. Walker. Heriot-Watt College, Edinburgh.—6.45 p.m.

I.E.S. (Cardiff centre).—"Lighting For Sports and Games," D. E. Beard. S. Wales Board demonstration theatre, The Hayes, Cardiff.—5.45 p.m.

FRIDAY, MARCH 3

A.S.E.E. (Liverpool branch).—"Ball and Roller Bearings." The Skefko Ball Bearing Co. Ltd., M. and N.W.E. Bd. Lecture Theatre, Whitechapel, Liverpool.—6.30 p.m.

INC. PLANT ENGRS. (Birmingham branch). — "Submersible Electric Motors and Centrifugal Pumps," C. Norman Terry. Imperial Hotel, Birmingham.—7.30 p.m.

I.E.S. (Bath and Bristol centre).—"Lighting of the Brabazon and Hangar," C. M. Robertson. S. Western Board showrooms, Bath.—7 p.m.

MONDAY, MARCH 6

ENGINEERS' SOCIETY.—"Oxygen and Other Gases and Their Application to Industry," R. E. Dore. Geological Society, Burlington House, W.—5.30 p.m.

JNR. INSTR. ENGRS. (N. Western section).—"Electrical Equipment of Large Machine Tools," T. Pickering. Manchester Geographical Society, 16 St. Mary's Parsonage, Manchester.—7 p.m.

I.E.E. (N. Midland centre).—Faraday lecture "Radar," Dr. R. A. Smith, Town Hall, Leeds.—7 p.m.

I.E.E. (Informal meeting).—"The Place of High Frequency in Industry," C. E. Eadon-Clarke. Institution, Savoy Place, W.C.2.—5.30 p.m.

I.E.E. (Mersey and N. Wales centre).—"The M.K.S. System of Units," E. Bradshaw. Liverpool Royal Institution, Colquilt St.—6.30 p.m.

I.E.E. (N. Western centre).—Jubilee Exhibition. Open 9 a.m.-8 p.m. daily until March 25. Central Library, Manchester.

I.E.S. (Sheffield centre).—"Show Window and Display Lighting," J. K. Frisby. Medical Library, The University, Western Bank, Sheffield 10.—6 p.m.

I.E.E. (S. Midland centre).—"The Design, Specification and Performance of H.V. Surge Diverters," H. F. Jones and C. J. O. Garrard. James Watt Institute, Birmingham.—6 p.m.

A.S.E.E. (Leeds branch).—"Gas Turbines," G. L. Duffett. Great Northern Hotel, Wellington St., Leeds 1.—7.30 p.m.

A.S.E.E. (Sheffield branch).—"Ripple Control," J. F. Mackenzie. Royal Victoria Station Hotel, Sheffield.—7.30 p.m.

I.E.E. (Western centre).—"Tidal Power and the Severn Barrage," H. Headlamp. South Wales Institute of Engrs., Park Place, Cardiff.—6 p.m.

TUESDAY, MARCH 7

I.E.E. (N. Western centres).—"Some Electrical Methods of Measuring Mechanical Quantities," F. J. Woodcock, Engineers' Club, Albert Square Manchester.—6.15 p.m.

INSTITUTE OF FUEL (London section).—"District Heating in the New Towns," A. E. Margolis. Inst. Mech. Engrs., Storey's Gate, S.W.1.—5.30 p.m.

A.S.E.E. (S.E. London branch).—"Portable Electric Tools," Mr. Greenfield. Castle Hotel, Eltham.—8 p.m.

A.S.E.E. (W. London branch).—"Relays and Remote Control," Dr. W. L. Stern. Hammersmith Town Hall, Hammersmith.—7.30 p.m.

I.E.E. (Measurements and Radio section).—"The Fundamental Limitations of Second-Harmonic-Type Magnetic Modulations as applied to the Amplification of Small D.C. Signals," Prof. F. C. Williams and S. W. Noble. "A New Theory of the Magnetic Amplifier," A. G. Milnes. Institution, Savoy Place, W.C.2.—5.30 p.m.

Daily Mail Ideal Home Exhibition.—Olympia, London. (Open until April 1.)

WEDNESDAY, MARCH 8

INC. PLANT ENGRS. (East Midlands).—"Lumens, Lamps and Lighting Economics, with Special Reference to Industrial Lighting," C. S. Gaunt. Welbeck Hotel, Nottingham.—7 p.m.

I.E.E. (N. Lancs. sub-centre).—"Selection of Transformers for use in Distribution Networks with Special Reference to the New Low-Voltage Standard of 240 Volts," E. Tobin. Technical College, Palatine Road, Blackpool.

I.E.E. (Southern centre).—"Recent Developments in Comparative Methods of Testing A.C. Electricity Meters," S. F. Musson and R. E. Mell. Brighton Technical College, Brighton.—6.30 p.m.

A.S.E.E. (Bradford branch).—"The Aims and Objects of the A.S.E.E.," H. Mellor. Midland Hotel, Bradford.—7.30 p.m.

A.S.E.E. (Coventry branch).—"Some Practical Aspects of Power Factor Correction Applied to Industrial Installations," H. R. Herring. Technical College, The Butts, Coventry.—7 p.m.

THURSDAY, MARCH 9

ASSN. MINING ELECT. AND MECH. ENGRS. (S. Wales branch).—"Experiences in the Maintenance and Repair of Power Generating Plant," W. M. Dodds. S. Wales Institute of Engrs., Park Place, Cardiff.—6 p.m.

INC. PLANT ENGRS. (Newcastle-on-Tyne branch).—"Manufacture and Application of Pyrotenax Insulated Copper-covered Cables," G. F. Hewett, Turks Head Hotel, Newcastle.—7.15 p.m.

E.P.E.A. (Northern meter and instruments (technical) group).—"Telemetering," H. Horwood. The Engineers' Club, Albert Square, Manchester.—7 p.m.

I.E.S. (Leicester centre).—"Film Studio Lighting," W. R. Stevens. Demonstration theatre, E. Midlands Board, Leicester Sub-area, Charles St., Leicester.—6.30 p.m.

I.E.E. (Utilisation section).—"The Application of Electric Discharge Lamps for Daylight Signalling," H. K. Bourne and E. J. G. Beeson. Institution, Savoy Place, W.C.2.—5.30 p.m.

FRIDAY, MARCH 10

I.E.S. (Birmingham centre).—"School Lighting—The Architect's Problem," A. M. Steel. Imperial Hotel, Temple St., Birmingham.—6 p.m.

E.P.E.A. (Southern Meter Engrs. group).—"The Testing of Transformer Oil," J. Romney. Caxton Hall, Westminster, S.W.1.—6.30 p.m.

I.E.S. (Exeter group).—"Lighting of the Brabazon and Hangar," I. M. Robertson. The Agricultural House, Queen St., Exeter.—7 p.m.

NEW COMPANIES

Extracted from the Register issued by Jordan and Sons, Ltd., 116 Chancery Lane, London, W.C.2.

Gilbert Electrical Tool Services Ltd. Cap.: £1,000. Dirs.: G. Thornton-Jones and G. A. Green.

H. C. Anderson (Electrical) Ltd., 24 High Rd., Chadwell Heath. Lighting consultants, mnfrs. of and dlrs. in elec. appliances and apparatus, etc. Cap.: £500. Dirs.: H. C. Anderson and Mrs. W. A. Anderson.

Thompson & Barlow (Electrical) Ltd., 13 Market Place, Kettering. Cap.: £3,000. Mnfrs. of and dlrs. in dynamos, motors, etc. Dirs.: F. T. Thompson and R. A. Barlow.

T. B. Hale Ltd., 19 Grace Rd., Ellesmere Port, Ches. Repairers of electrical goods and installations, etc. Cap.: £800. Dirs.: S. Collier, T. B. Hale and C. Collier.

More Power for Barnes

These pictures show work in progress on a large contract carried out by Henley's Contract Department for the B.E.A. in the Wandsworth-Barnes district, where the growing demand requires reinforcement of the 66 kV. transmission network. Henley's are specialists in super-tension cable technique, and their wide experience is available for any problem connected with power transmission.

HENLEY CABLES

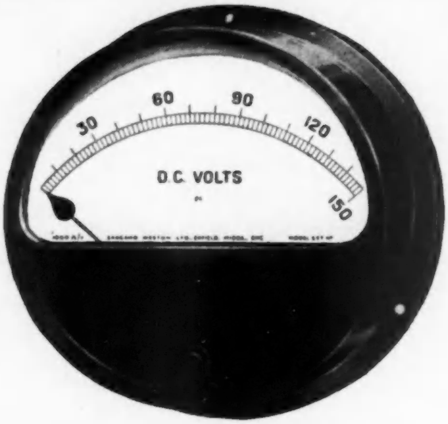
Illustrations: Laying Henley 66kV Gas Cushion Cable on the Wandsworth-Barnes route.

Consulting Engineers :
Messrs. Merz & McLellan.

BY APPOINTMENT
ELECTRIC CABLE
MANUFACTURERS

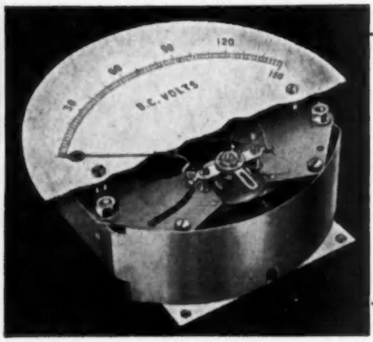
W. T. HENLEY'S TELEGRAPH WORKS CO. LTD., 51-53 HATTON GARDEN, LONDON, E.C.1

FEATURES OF WESTON SUPERIORITY



Weston
MOVING COIL SWITCHBOARD INSTRUMENTS

Combining the sensitivity of a laboratory instrument with the robust qualities of a switchboard pattern, this new series of 'Weston' permanent-magnet, moving coil instruments represents a great advance in design and technique. They incorporate thermocouples and rectifiers where necessary. Special features include efficient damping, the new standard 'Weston' patented spring-loaded jewel to protect the pivot, magnetic shielding and a high degree of accuracy. Mounted in attractive bakelite cases, flush fitting or projecting, the 6″ easily read scale is printed in black on white enamel. All instruments conform to B.S.I. Spec. No. 89. Special enquiries will receive the personal attention of our Technical experts. The model S57 illustrated is supplied as a D.C. Microammeter, Milliammeter, Millivoltmeter, Ammeter and Voltmeter, all with a variety of ranges.



MAGNETIC SHIELDING. To prevent interference from external magnetic fields and to reduce those due to the instrument, it is magnetically shielded as shown. The high degree of accuracy of these instruments is in no small measure due to this 'Weston' design.

SANGAMO WESTON LIMITED

ENFIELD, MIDDLESEX · Telephone Enfield 3434 (6 lines) & 1242 (4 lines)

CLASSIFIED ADVERTISEMENTS

OFFICIAL TENDERS
AND APPOINTMENTS

FOR SALE · WANTED
WORK WANTED

Those wishing to advertise in these pages should send the text to the Classified Advertisement Dept., Electrical Times, Sardinia House, Sardinia St., W.C.2, before 10 a.m. on TUESDAY of week of issue. Official Displayed Advertisements are charged at 35s. per inch, and all other classified advertisements at 2s. 6d. per line. Situations Wanted will be published four times for twice the single insertion rate. Fee for Box No. and postage on replies is 2s.

TENDERS INVITED

METROPOLITAN BOROUGH OF WANDSWORTH

APPLICATIONS are invited from firms of electrical contractors desirous of being placed on the Council's list of firms who may be invited to submit quotations from time to time for the execution of the following works, viz:—

1. For electrical installation works, in connection with development of small permanent housing schemes, up to an estimated value of £500.
2. For electrical installation works (including power), in connection with the development of major permanent housing schemes, over an estimated value of £500.

Preference will be given in the case of (1) to local firms.

Applications (which must be made on the official form to be obtained from the Borough Architect, Municipal Buildings, Wandsworth, S.W.18) must be delivered to the Town Clerk, Municipal Buildings, Wandsworth, S.W.18, so as to be received not later than 12 noon on Wednesday, March 22, 1950.

R. H. JERMAN,
Town Clerk.

February 25, 1950.
Municipal Buildings, Wandsworth, S.W.18. (E 34)

COUNTY BOROUGH OF DARLINGTON

RE-WIRING OF CHEMICAL HOUSE AND FILTER HOUSE AT DARLINGTON CORPORATION WATERWORKS

THE Corporation invite tenders for the internal Re-wiring of the Filter House and Chemical House at the Corporation Waterworks, Coniscliffe Road, Darlington.

The plan, specification, schedule of fittings, and form of tender may be obtained on application to the Borough Surveyor, Town Hall, Darlington, upon payment of a deposit of £2 2s., which sum will be returnable on submission of a bona fide tender. Cheques are to be made payable to the "Corporation of Darlington."

Tenders must be enclosed in a plain sealed envelope endorsed "Tender for Wiring at Waterworks" and forwarded to reach the undersigned on or before Wednesday, March 22, 1950. The envelope must not bear any name or mark indicating the sender.

H. HOPKINS,
Town Clerk.

11 Houndgate, Darlington. (E 29)

APPOINTMENTS VACANT

None of the vacancies in these columns relate to a man between the ages of 18 and 50 inclusive, or a woman between the ages of 18 and 40 inclusive, unless he or she is excepted from the provisions of the Control of Engagement Order, 1947, or the vacancy is for employment excepted from the provisions of that Order.

SOUTH EASTERN ELECTRICITY BOARD

INSTALLATION ENGINEER, Eastbourne district. Provisional salary £443 per annum, rising to £458 per annum. Superannuation will be arranged.

Applicants must be capable of preparing specifications and estimates, dealing with correspondence, the carrying out of complete installations of all types, and must have a thorough knowledge of the Electricity Supply Regulations, and the Institution of Electrical Engineers Regulations for the electrical equipment of buildings. The appointed person will be responsible to the consumers' engineer for the section comprising wiring personnel.

Applications, giving two referees, must reach N. Boydell, Esq., M.I.E.E., A.M.I.Mech.E., East Sussex and S.W. Kent Manager, South Eastern Electricity Board, Electric House, Grove Road, Eastbourne, by March 18, 1950.

A. L. BURNELL,
Secretary.

February, 1950. (E 38)

NORTH WESTERN ELECTRICITY BOARD

No. 3 Sub-Area

APPOINTMENT OF METER REPAIRERS (MECHANICIANS)

APPLICATIONS are invited for the above positions in the Sub-Area Testing Station at Stalybridge.

The terms and conditions of employment will be in accordance with those laid down by the National Joint Industrial Council for the Electricity Supply Industry, the present rate of pay being 35.00d. per hour for a 44-hour week.

Applicants should be experienced in the repairing of all types of electricity meters and meter mechanisms.

Applications, giving full details of training and experience, together with any technical qualifications, should be received by E. Binns, Esq., M.I.Mech.E., A.M.I.E.E., Sub-Area Manager, No. 3 Sub-Area, The North Western Electricity Board, Greenhill Offices, Oldham, not later than March 17, 1950.

The above vacancies are advertised by permission of the Ministry of Labour and National Service under the Control of Engagement Order, 1947. (E 24)

BRITISH ELECTRICITY AUTHORITY

North Western Division

APPLICATIONS are invited for the following positions:

(1) ASSISTANT CHARGE ENGINEER at Kearsley Generating Station.

Candidates should possess technical qualifications, and experience in a large modern generating station will be an advantage.

Salary will be in accordance with Class "M", Grade 8a, of the N.J.B. Schedule, i.e. £642 to £670 per annum.

(2) GENERAL ASSISTANT ENGINEER in the System Operation Department at Divisional Headquarters.

The duties are of a general technical and statistical nature in connection with power station operation and include shift duties in the grid control room.

The post is graded within the range £392 8s. to £523 13s. Graduateship of the Institution of Electrical Engineers or possession of equivalent qualifications is desirable.

Applications, stating age, qualifications, present position, salary, together with full details of experience, should be received by the Establishment Officer, British Electricity Authority, British Electricity House, Wilmslow Road, East Didsbury, Manchester 20, not later than seven days after the appearance of this advertisement. (E 30)

BRITISH ELECTRICITY AUTHORITY

Eastern Division

APPLICATIONS are invited for the following appointment:—

SHIFT CHARGE ENGINEER, Thorpe Generating Station, Norwich.

Salary in accordance with N.J.B. Schedule, Grade 8, Class "H" (£520-£547 per annum).

Applicants should have served an apprenticeship and obtained an Ordinary National Certificate in Electrical and/or Mechanical Engineering or equivalent and possess experience in the operation of Power Stations.

The salary is in accordance with the scale at present operating but may be subject to negotiation through the medium of the Joint Board.

The appointment will be superannuable in accordance with the British Electricity Authority and Area Boards' Superannuation Scheme.

Applications, stating age, experience and present position, should be sent to the Divisional Controller, British Electricity Authority, Eastern Division, Northmet House, Southgate, N.14, to arrive not later than March 11, 1950. Envelopes should be endorsed "Shift Charge Engineer, Norwich."

W. N. C. CLINCH,
Controller.

Northmet House, Southgate, N.14. (D 604)

SOUTH WESTERN ELECTRICITY BOARD

APPLICATIONS are invited for the following appointments:—

(a) ASSISTANT CONSTRUCTION ENGINEER (overhead), Bath District, with headquarters at Bath. Salary £414 p.a. (Grade 9, Class "G" of the N.J.B. Schedule).

(b) ASSISTANT CONSTRUCTION ENGINEER (overhead), Weston District, with headquarters at Weston-super-Mare. Salary £414 p.a. (Grade 9, Class "G" of the N.J.B. Schedule).

Candidates should be experienced in O/H line planning and construction, requisition of materials, preparation of notices and plans, and control of labour in the field.

Qualifications leading to Corporate Membership of the I.E.E. will be an advantage.

(c) TECHNICAL ASSISTANT to Deputy Sub-Area Manager (Engineering), Bristol and North Somerset Sub-Area, with headquarters at Bristol. Salary £562 p.a. (Grade 9, Class "M" of the N.J.B. Schedule).

Candidates should have a good general knowledge of distribution work and possession of an engineering degree will be an advantage. The duties include collation of statistics and preparation of technical data and reports.

(d) (i) BRANCH MANAGER, Lynton and Lynmouth, with headquarters at Lynton, Devon. (Provisional salary £550 per annum.)

(ii) BRANCH MANAGER, South Molton, with headquarters at South Molton, Devon. (Provisional salary £525 per annum.)

The successful applicants will be responsible for the operation and maintenance of the local distribution system, including construction work, installation of services, metering, etc., and for the commercial development of the Branch.

Applicants should have had good engineering experience and some commercial experience is necessary. Graduate or Associate membership of the I.E.E. will be an advantage.

The salaries for all these appointments are provisional pending the adoption of nationally negotiated scales.

Detailed applications stating for which post candidates desire to be considered to be submitted to Assistant Secretary (Establishments), South Western Electricity Board, Electricity House, Colston Avenue, Bristol 1, within ten days. (D 745)

BRITISH ELECTRICITY AUTHORITY

East Midlands Division

APPLICATIONS are invited for the positions of GENERAL ASSISTANT TECHNICAL ENGINEERS in the Technical Department of this Divisional Headquarters.

Applicants should hold the Higher National Certificate and preferably a university degree in electrical engineering. Experience in commissioning and maintenance testing of generating and sub-station protective gear would be an asset.

Salary will be within the provisional range £392 8s. to £523 13s. per annum, which will be subject to negotiations by the appropriate organisation.

The post will be superannuable under the British Electricity Authority's Superannuation Scheme.

Applications should be submitted on the appropriate form, which may be obtained from the Divisional Establishments Officer at the undermentioned address, and should be delivered to the undersigned not later than March 20, 1950.

W. S. BURGE,
Divisional Controller.

British Electricity House,
Barker Gate, Nottingham.
(E 22)

SOUTHERN ELECTRICITY BOARD

No. 4 (Bournemouth) Sub-Area

APPOINTMENT OF DEMONSTRATOR (FEMALE)

APPLICATIONS are invited for the post of Demonstrator (Female) at Yeovil District of the Board.

Applicants should be qualified to advise generally on the utilisation of electrical appliances, to give cookery demonstrations in showrooms and in the homes of consumers, and to assist in showrooms duties.

The appointment is subject to the provisions of a Contributory Staff Superannuation Scheme, membership of which is compulsory for those eligible to join.

The salary will be within a range of £290-£330 per annum, in accordance with Grade "A" of the National Joint Council's Extended Interim Scheme of Salaries for Administrative and Clerical Staffs, and the appointment will be subject to National Joint Council Conditions of Service.

Applications on forms obtainable from the Sub-Area Secretary at 1 Priory Road, Bournemouth, Hants, must reach him in envelopes endorsed "Demonstrator, Yeovil", in the top, left-hand corner not later than March 13, 1950.

F. W. KEMPTON,
Secretary.
(E 36)

BRITISH ELECTRICITY AUTHORITY

South Wales Division

APPLICATIONS are invited for the appointment of an ASSISTANT ELECTRICAL MAINTENANCE ENGINEER at East Power Station, Newport, at a salary in accordance with the National Joint Board Schedule, Class " H," Grade 8b (£465-£484 per annum).

Applicants should have obtained the Higher National Certificate or its equivalent; had full apprenticeship in works engaged in the manufacture of electrical plant; and had some recent experience in work of a similar nature.

The appointment is superannuable under the British Electricity Authority and Area Boards Scheme.

Forms of application may be obtained from the Divisional Secretary at the address below, to whom completed applications should be returned not later than March 10, 1950, in sealed envelopes endorsed " Assistant Electrical Maintenance Engineer."

H. V. PUGH,
Divisional Controller.

Cardiff (Pengam Moors) Airport,
Cardiff.
(E 11)

NORTH OF SCOTLAND HYDRO-ELECTRIC BOARD

DISTRIBUTION ENGINEER required for the Board's Skye and Lochalsh Area. Salary, which will depend on qualifications and experience, will not be less than £500 per annum. Salary will be provisional in the first instance and subject to adjustment by the appropriate negotiating machinery.

Applications to: T. Nicolson, B.Sc., A.M.I.E.E., Area Manager, North of Scotland Hydro-Electric Board, Kyle of Lochalsh, Ross-shire. (D 715)

LONDON ELECTRICITY BOARD

APPLICATIONS are invited for the position of ENGINEER (TEST) in the Meter and Testing Branch of the Northern Sub-Area. Initially the successful candidate will be based at Islington, but he must be prepared to work anywhere in the Northern Sub-Area.

Applicants should have had a sound technical education and obtained the Higher National Certificate in electrical engineering, or the equivalent and possess sound practical experience in connection with the testing of protective equipment, high and low voltage switchgear and instruments, cable fault location, general testing work on a high voltage network. A knowledge of the application of electronics is desirable.

The commencing salary will be from £550 per annum dependent on qualifications and experience. This salary is provisional and subject to adjustment through the appropriate negotiating machinery.

Application forms, obtainable from the Establishments Officer, 46-47 New Broad Street, E.C.2, on receipt of an addressed foolscap envelope, should be returned, duly completed, not later than March 9, 1950. Please mark envelope EST/V/590/T. (E 33)

THE STATES OF GUERNSEY

APPLICATIONS are invited for the appointment of ENGINEER-MANAGER of the States of Guernsey Electricity Department. The department supplies the Island of Guernsey, C.I., an area of about 25 sq miles and population of over 44,000. The power station (Class D) generates entirely by diesel alternators and output at present is over 16 m. per annum. Staff employed is about 150.

Candidates must have had experience as a senior official in the control, management and development of an Electricity Supply Undertaking and will be expected to co-ordinate the technical, sales and accountancy sub-departments, plan extensions of plant, mains and sub-stations, and prepare statistics and estimates for presentation to the States Electricity Board and be responsible for carrying out its instructions and policy.

Candidates should hold either a university degree in engineering or be corporate members of the Institute of Electrical, Mechanical or Civil Engineers.

The successful candidate will be required to pass a medical examination.

Non-contributory pension rights are governed by the States Civil Service Pensions Rules. It is a condition of appointment that the appointee contribute to the Contingency Fund to provide pensions to widows and orphans of members of the States Civil Service. Particulars of pension rights and of Contingency Fund rights and obligations are obtainable on application to the States Supervisor, States Office, Guernsey.

Salary £1,080-£1,260. The commencing salary and increments will be fixed in accordance with the qualifications and experience of the successful candidate. In addition to salary there is a temporary cost of living bonus (£50 p.a. married men, £25 p.a. single men).

Applications giving age, qualifications and full experience, accompanied by the names of three referees, must be received not later than Monday, March 20, 1950, addressed to: The President, States Appointments Board, Royal Court, Guernsey, C.I.

Canvassing for appointment is forbidden. (D 714)

BRITISH ELECTRICITY AUTHORITY

South Western Division

ASSISTANT CHEMIST

APPLICATIONS are invited for the position of Assistant Chemist in the South Western Division.

Applicants should preferably possess a University qualification in Chemistry or the Associateship of the Royal Institute of Chemistry, but extensive experience in Chemistry applicable to Power Stations would be considered in lieu of the qualifications mentioned.

The salary for this position will be within one of the following provisional scales according to qualifications and experience:—

(a) £392 8s., rising by annual increments to £523 13s.
(b) £534 3s., rising by annual increments to £665 8s.

These salary scales will be regarded as provisional and subject to negotiation by such organisations as are appropriate.

Applications, stating age, qualifications, experience, present position and salary, should be addressed to the Divisional Secretary, British Electricity Authority, South Western Division, British Electricity House, 26 Oakfield Road, Bristol, 8, so as to be received not later than March 20, 1950.

R. C. BARRETT.
Divisional Secretary.

February 27, 1950. (E 39)

YORKSHIRE ELECTRICITY BOARD

No. 4 Sub-Area

PLUMBER JOINTER (Class 1) required for the Leeds district. Applicants should have had wide experience in all classes of jointing from service connections up to and including all types of substation equipment at 11,000 volts.

Wages and conditions of employment in accordance with N.J.I.C. agreement.

Applications in writing, stating age, qualifications and experience to be addressed to "The Manager, Yorkshire Electricity Board, No. 4 (Leeds) Sub-Area, 1 Whitehall Road, Leeds 1," within seven days of the appearance of this notice. (E 37)

A DESIGNER/DRAUGHTSMAN required by manufacturers of "Temco" domestic electrical accessories. Must be familiar with the light electrical apparatus industry.—Write, giving full details of experience and salary required, to Personnel Manager, Telephone Manufacturing Co. Ltd., Martell Road, West Dulwich, S.E.21. (E 12)

AN ELECTRICAL ENGINEER with experience of steelworks or other heavy engineering, required. Salary £800 upwards.—Reply to Box No. 1871, Electrical Times. (D 681)

AN important firm of ELECTRICAL ENGINEERS has a vacancy for a well-qualified man to take charge of department responsible for sales of wide range of instruments and meters.—Applicants should send full schedule of particulars, relating to general, technical, and commercial education, positions held, remuneration received and age, to Box No. 1017, Electrical Times. (E 20)

AN old-established, progressive company is forming a pool of YOUNG TECHNICIANS for appointments on its production, research, and technical sales staff, which, in some instances, may lead to executive positions.

Applications are invited from graduates under 28 years of age in electrical engineering, physics, or chemistry. Selected candidates would be given 12 to 18 months' training in the company's methods at headquarters in Redditch, after which they would be eligible for appointment at home or abroad; in special cases, e.g., war service, consideration would be given to non-graduates, but a high standard of ability will be required.—Box No. 1015, Electrical Times. (E 16)

APPLICATIONS are invited from qualified TECHNICAL SALES ENGINEERS conversant with rotating electrical machinery, switchgear and transformers to fill positions in London office organisation. The positions will carry considerable responsibility, and applications should be made in confidence to The Manager, The Brush Electrical Engineering Co., Ltd., Duke's Court, 32 Duke Street, St. James's, S.W.1. (E 5)

APPLICATIONS are invited for the following positions in our Electric Motor Department: DESIGNER; WINDING SHOP FOREMAN; and TEST ENGINEER.—British Bronson Ltd., Stocklake, Aylesbury. (D 615)

COMPANY manufacturing Selenium Metal Rectifiers in Boreham Wood, Herts, have vacancy in SALES ENGINEERING OFFICE for man with sound training in electrical engineering to hardle preliminary design, preparation of estimates and general sales correspondence.—Write, giving age, qualifications, experience and salary required, to Box No. 1003, Electrical Times. (E 2)

CONSULTING Engineers have vacancies for young ELECTRICAL ENGINEERS wanting experience in heavy industrial installation work. Applicants must have degree or equivalent and be trained by one of the larger firms.—Reply to Box No. 1869, Electrical Times. (D 680)

CONTRACTS ENGINEER required, London area. Age 35-40. Estimating, costing, supervision. Full experience in p.i. cable and switchgear installations; jointing e.h.t. and l.t. excavation; o.h. line work. H.N. Certificate or equivalent. Permanent position and prospects. Apply, in writing, stating age, experience, and salary required.—Box No. 1863, Electrical Times. (D 675)

ELECTRICAL DESIGN DRAUGHTSMEN. Higher National Certificate; experienced industrial distribution, including power and lighting.—Write, stating age, experience, and salary desired to Staff Officer, Imperial Chemical Industries, Ltd., Metals Division, Birmingham 6l (E 27)

ELECTRICAL Engineering Company in Boreham Wood, Herts, have a vacancy for ENGINEER with experience of preparing technical catalogues, sales literature and instruction hand-books, etc.—Write, giving age, experience and salary required, to Box No. 1005, Electrical Times. (E 3)

ELECTRICAL ENGINEER, Higher National or equivalent required by Company in Boreham Wood, Herts, manufacturing Selenium Metal Rectifier equipment.—Write, stating age, qualifications, experience and salary required, to Box No. 1001, Electrical Times. (E 1)

ELECTRICAL ENGINEER. Written applications in duplicate, giving full details of training and experience and enclosing testimonials, addressed to Messrs. Hunt, Leuchars and Hepburn, Market Buildings, 29 Mincing Lane, London E.C.3, are invited for the post of Electrical Engineer with an important engineering concern in Salisbury, Rhodesia. The following qualifications are desirable: Commercial, sales and operational experience; experience in heavy plant, distribution and industrial equipment, including lighting. A B.T.H. trained man is preferred. Passage to Rhodesia provided. Remuneration £960 to £1,200 or according to qualifications and experience. (E 13)

ELECTRICAL INSPECTORS required by major oil company operating in Middle East. Applicants should have a wide experience of inspection and testing of motors, switchgear, and the electrical equipment associated with modern large generating stations, substations, and transmission and distribution networks with voltage range of 33 kV to 440 V. Knowledge of flameproof equipment an advantage. Possession of Higher National Certificate essential and qualifications up to A.M.I.E.E. desirable. Age limit 37 years. Attractive salary, plus generous allowance in local currency, free passages out and home, free medical attention, kit allowance, pension scheme, good leave arrangements.—Write, stating age and full details of qualifications and experience, quoting Dept. F.182, to Box 2333 at 191 Gresham House, E.C.2. (C 304)

EXPERIENCED ORDER CLERK at our Leyton Depot. State age, wages, experience.—M.D., Sloan Electrical Co. Ltd., 31-33 Bondway, S.W.8. (D [illegible])

FLUORESCENT Lighting Fittings manufacturers, producing extensive range of industrial fittings, require additional REPRESENTATIVES with established entree to distributors, large users, and contractors. Experience of illumination essential. Only men with proved sales record and used to substantial earnings considered.—Micramatic Limited, Congleton, Cheshire. (D 677)

IMPERIAL CHEMICAL INDUSTRIES, LTD., Alkali Division, Northwich, has vacancies for ELECTRICAL DRAUGHTSMEN. Applicants must have the Higher National Certificate (Electrical) or equivalent, and must be capable of turning out a good drawing and making layout drawings for industrial electrical equipment and distribution schemes. Salary will be discussed at interview. Housing in pleasant rural area can in certain cases be made available within three to four months of commencing employment.—Applications should be addressed to Staff Manager, Imperial Chemical Industries, Ltd., Alkali Division, Winnington, Northwich, Cheshire. (E 16)

JUNIOR DRAUGHTSMAN required for detail and assembly drawing, modifications and schedule preparation for manufacturers of electro-mechanical devices in West London area.—Write full details of experience and salary required to Box No. 1007, Electrical Times. (E 4)

METROPOLITAN-VICKERS ELECTRICAL CO., LTD., Trafford Park, Manchester 17, require for their transformer drawing office:—

(a) SENIOR DRAUGHTSMEN experienced on large and medium-power transformers.
(b) SENIOR DRAUGHTSMEN experienced on high voltage current and voltage transformers.

Electrical and mechanical experience is essential.

Apply in writing, stating age, experience, and technical qualifications, marking envelopes "Transformer D.O.," to Personnel Manager, Trafford Park, Manchester 17. (D 699)

REPRESENTATIVE required by eminent London Electrical Wholesalers for S.W. and N.W. London areas. Established connections essential.—Box No. 1011, Electrical Times. (E 8)

BOX No. replies to be addressed to the ELECTRICAL TIMES, Sardinia House, Sardinia Street, London W.C.2

OIL-REFINERY CONTRACTORS require a qualified ENGINEER to be responsible for specifying and selecting all types of pumps, motors, turbines, compressors, etc., used in the refining industry.—Write fully, Foster Wheeler, Ltd., Aldwych House, Aldwych, London W.C.2. (D 742)

REPRESENTATIVE (experienced), preferably resident Bristol area, required for territory covered by South Western and South Wales Boards to call on wholesalers, contractors, electricity boards, etc., to sell Temco wiring accessories and clocks. Salary, commission, expenses, and car provided.—Applications treated strictest confidence and should state age, experience, and total remuneration expected. T. M. C., Harwell (Sales), Ltd., 37 Upper Berkeley Street, London W.1. (E 17)

SALES AND GENERAL MANAGER with executive experience, for expanding retail radio and television firm. Applicant should be a member of I.S.M.A., have first-class sales and administration record, plenty of initiative, have held similar position in the radio trade. Salary and commission £800 per annum.—Apply by letter only, giving full details, to: Whites Ltd., 62 Swan Street, Manchester. (D 692)

SENIOR AND JUNIOR ELECTRICAL DESIGNERS required by well-known company in Manchester area engaged in manufacture of all classes of A.C. and D.C. Dynamo Electric Machines from 5 to 5,000 H.P./K.W. Salary according to qualifications and experience.—Box No. 1025, Electrical Times. (E 42)

SENIOR DRAUGHTSMAN for detailing l.t. metal clad switchgear, minimum qualifications National Certificate in electrical engineering. A.E.S.D. rates, 5-day week.—G. P. Dennis Ltd., Fleming Road, Speke, Liverpool 19. (D 711)

SUPERINTENDENT required for transformer manufacturing section of large works in the Midlands. Sizes range from 15 kVA to 45 MVA at 132 kV, and applicants should have a sound knowledge and some years responsible supervisory experience in the manufacturing processes involved in this class of work. The position is an important one, and will carry a commensurate salary with participation in a staff assurance scheme. Assistance with accommodation will be given if necessary.—Write fully, giving age, qualifications, experience and details of salaries earned, to Box No. 1023, Electrical Times.(E 32)

TECHNICAL ASSISTANTS and DRAUGHTSMEN required for London with experience of Overhead Transmission Lines. Salary according to qualifications and experience. Apply in writing to the Staff Officer, British Insulated Callender's Construction Company Limited, 21 Bloomsbury Street, London W.C.1. (E 41)

THE Ford Motor Company require to fill the following staff engineering appointments in their Power House—present capacity equivalent to 70,000 kW.

(a) ASSISTANT SHIFT CHARGE ENGINEER
(b) ASSISTANT MECHANICAL MAINTENANCE ENGINEER.

Candidates for both positions should be in possession of technical qualifications admitting to corporate membership of a recognised professional institute.

Applicants for (a) must have a sound technical training and be experienced in all branches of engineering associated with the design and operation of high pressure boiler and turbine plant. Starting salary approximately £700 per annum.

Applicants for post (b) must have extensive experience in mechanical maintenance of modern high pressure power station plant including large turbines, boilers, pumps, conveyors, lifting gear, etc., and be competent in handling labour. Salary approximately £650 per annum.

Both positions are pensionable and permanent and have good prospects.

Applicants should apply very fully to the Labour Relations Division, Ford Motor Company, Dagenham, quoting the reference E/JKH/PH, and indicating for which of the two positions they would wish to apply. (E 6)

APPOINTMENTS WANTED

GRADUATE, age 24. A1 personality, G.I.E.E., G.I.P.E., Stud.I.I.A., desires progressive position Birmingham area. Salary of secondary importance. Gen. eng. experience.—Box No. 1027, Electrical Times. (E 43)

WORK WANTED

ARMATURE ROTOR AND STATOR WINDING. We specialise in the repair and rewind of all types of electrical machines from fractional h.p. upwards. Special departments for vacuum cleaners, dryers, portable tools, etc. All work fully guaranteed.—Walter Crane, Greencoat Electrical Works, Westgate, Wakefield. Telephone 2172. (A 4)

A.C. and d.c. Motor Rewinds and Repairs. Prompt service, fully guaranteed.—Edgware 8631 (4 lines). Service Electric Co. Ltd., Stanmore, Middx. (D 324)

BUSINESS wanted. Electrical repair works in London. Room for development.—Box No. 1013, Electrical Times. (E 9)

CASTINGS, Fisher Foundries, Ltd., Greet, Birmingham, have capacity for brass, gun metal and soft grey iron machine moulded repetition castings weighing 1-30 lb. Loose pattern work up to 3 cwt. Delivery by road to all parts. Tel.: B'ham. Victoria 0197. (D 326)

MILD STEEL BLANKS, ⅛ in. thick upwards, rounds, squares or irregular shapes, flame cut to your drawings; repetition quantities, prompt deliveries.—Heaton Ward Ltd., Bath Street, Birmingham 4. Cen 1146. (D 674)

ZEROS REFRIGERATORS.—Complete range of repair and service now available. Equipment reconditioned to conform to pre-war manufacturers' specifications.—Time Engineers, Refrigeration Specialists, 60 Southend Road, Rainham, Essex. Tel.: Rainham 2358: or Southern Area Agency. Tel.: Springpark 4217. Electrical Spares supplied to the trade. (A 639)

WANTED

A.C./D.C. MOTORS, STARTERS, complete change-over installations, etc.—A.A.Electrical Co., Ltd., 67 Rothschild Road, Chiswick Park, W.4. 'Phone: Chiswick 5105. (A 20)

ONE 150 kW GENERATOR 220 V. d.c., 600 r.p.m. compound wound machine.—Box No. 1853, Electrical Times. (D 633)

ONE 100 kVA, 400 V, 3-phase, 50 cycles Salient Pole type ALTERNATOR, 1,000 r.p.m. Complete with switchboard.—Box No. 1009, Electrical Times. (E 7)

ONE 400 V. 3-phase, 50 cycles totally enclosed slip ring INDUCTION MOTOR, 10 h.p., 720 r.p.m.—Box No. 1837, Electrical Times. (D 618)

SCRAP ACCUMULATOR PLATES and Sediment wanted, any quantities. Also Storage Batteries purchased and dismantled.—Phone or write Elton Levy Co., Ltd., St. Ermin's (West Side), Caxton Street, London S.W. Phone: WHItehall 9621/2/3. (A 3)

STAINLESS STEEL. SHEET, BAR AND TUBE bought best prices.—Taylor Stainless Metals Ltd., Slough; Bucks. Tel. 21381. (C 800)

WANTED.—D.C. and a.c. ball-bearing MOTORS.—Full details to Britannia Manufacturing Co., Ltd., 22/26 Britannia Walk, London N.1. (A 13)

WANTED for prompt cash, ferrous and non-ferrous SCRAP; also plant for dismantling. Buyers of second-hand machinery and plant for re-use.—W. and H. Cooper, Ltd., 176 Brady St., Bethnal Green, E.1. (A 1)

WANTED, ROTARY CONVERTERS, any size.—Universal, 221 City Road, London E.C.1. (A 16)

WANTED.—Large quantity of 4-in. outside diameter TUBES from the dismantling of old Babcock Water-tube Boilers. Best prices paid. Prepared to purchase Babcock and Wilcox Water-tube Boilers for dismantling.—Apply, giving full details, to Midland Iron and Hardware Co., Cradley Heath. (A 5)

400 V. 3-phase 60 c/s ALTERNATORS, 1,200 or 1,800 r.p.m., 100 kVA.

One 100 kW, 460/230 V, 3 wires, d.c. GENERATOR at a.c. motor driving synchronous speeds. Alternatively, Mercury Arc Rectifier to give same output, with incoming supply 400 V. 3-phase, 50 c/s.—Box No. 1859, Electrical Times. (D 655)

FOR SALE

CABLES & WIRE

CABLE. 10,500 yd. 1/·044 lead sheathed Twin Cables in coils packed in 14 cases C.M.A. Spec. Absolutely new.—Unimex (London) Limited, 46 Museum Street, London W.C.1. (D 673)

BANKRUPT CABLE

TWIN TRS	per 100 yds	SINGLE VIR Taped & braided	per 100 yds
3·029	59/6	3·029	22/-
with earth	66/9	7·029	36/-
7·029	89/6	1·044	17/3
with earth	102/6	14·36 TT MAROON	14/9 for 50
1·044	45/6		

Cash with order. All goods guaranteed, add part carriage on small orders. SEND FOR 'SMALL QUANTITY' discounts and bakelite accessories list.

BRITISH DISTRIBUTING CO.
66 HIGH STREET, LONDON N.8 (D 517p)

CONTRACTORS. One or two large buyers required to contact manufacturer of WIRES, CABLES and FLEXIBLES of first-rate quality.—Box No. 1867, Electrical Times. (D 679)

PAPER INSULATED ARMOURED CABLES to BSS 480/1942. Considerable stocks available.—Cable Jointers, Ltd., 49 Avenue Road, W.3. Acorn 4831/2. (D 319)

TOUGH RUBBER CABLE available, all sizes and types; non-standard lengths (25 yds to 50 yds). Special prices quoted for regular buyer. Must be a user. Guaranteed strictly to BSS.7.—Box No. 1849, Electrical Times. (D 629)

V.I.R., TAPED AND BRAIDED Fully complying with BSS specification, but non-standard lengths. First-rate quality, ex. works. Must be actual user.—Box No. 1865, Electrical Times. (D 678)

700 YDS. of RED V.I.R. 19·083 new.—Offers to Grant Electric Co., Ltd., Grant Road, Croydon. Tel.: ADD. 5453. (E 31)

DOMESTIC APPLIANCES

IMMERSION HEATERS. Grubb 2 kW and 3 kW standard voltages, all lengths, 12 in. to 36 in. Also 4 kW (non-taxable), 16 in. to 36 in. Fully guaranteed and immediate delivery. For illustrated brochure, latest lists, and trade terms, write distributors, John Owner and Co., Springfield Road, Birmingham 13. Tel.: Spr. 2939. (C 392)

ENGINEERING PLANT & MATERIALS

ALUMINIUM ALLOY. Special offer: 6ft x 3ft x 24 gauge flat or corrugated sheets, £9 9s. per dozen. Also angles available. All prices, carriage paid. Delivery ex-stock.—Sawyers Manufacturing Co., Ltd., Bures, Suffolk. Tel.: Bures 351/2. (B 335)

FOR SALE, 500,000 Brass Screws, 15/16 in.x2 BA, cheese head. Not boxed. Offers.—Box No. 1019, Electrical Times. (E 21)

LADDERS (wooden and aluminium, all types). Trestles, Steps, Handcarts, etc., from Ramsay and Sons (Forfar) Ltd., Forfar (Tel. 172). (C 603)

NEW 250 KW/H BASTIAN ALLEN ELECTRODE STEAM BOILER. 80 lb/sq. in. 400 V. 3 ph. 50 A.C. Control Panel, O.C.B., Boiler mountings. Spare electrodes, valves, etc. Operation only March 1949 to September, 1949. Inspection invited. Highest offer accepted.—Arding and Hobbs Ltd., Clapham Junction, S.W.11. (E 45)

ONE STANDARD FREMANTLE 1 (FW1) Coil Winding machine complete with motor and switchgear. The machine is in excellent condition and has only been in operation a few hours. Best offer to Mawdsley's Ltd., Dursley, Glos. (E 44)

TUBING of all sizes. Send us your inquiries.—Dept. C, Dismantling and Engineering (Midlands), Ltd., Cardale Street, Blackheath, Birmingham. Tel.: BLAckheath 1200. 1841-2. (E 35)

GENERATING PLANT

BRITISH ELECTRICITY AUTHORITY

North Western Division

TENDERS are invited for the Purchase, Dismantling and Removal of the following redundant plant situated at Stuart Street Generating Station, Bradford, Manchester 11:—

2 Motor Generators by the Electrical Co., Ltd.; 6,500/200 V, 220 kW.

1 Motor Generator by Metropolitan-Vickers Electrical Co., Ltd.; 6,500/400 V, 2,000 kW.

1 Motor Converter by Bruce Peebles and Co., Ltd.; 6,500/400 V, 1,270 kW.

1 Motor Converter by Bruce Peebles and Co., Ltd.; 6,500/420 V, 1,000 kW.

General conditions and form of tender can be obtained from the undersigned.

The Authority does not bind itself to accept the highest or any offer.

P. H. FLATT,
Divisional Secretary.

British Electricity House,
Wilmslow Road, East Didsbury, Manchester 20. (E 15)

ALTERNATING SET for sale. Motor driven on base-plate. Input 70 h.p., 1,500 r.p.m. D.C. Output 400 volts, 1 phase, 50 cycles, 36 kVA. With generator to give voltage variation, starter, shunt regulator and A.C. voltmeter.—F. J. Edwards, Ltd., 359 Euston Road, London N.W.1. Euston 4681. (E 40)

ALTERNATORS, modern ball-bearing machines almost equal to new, 400 V, 3-phase, 50 c/s, 4-wire, 1,500 r.p.m., with inbuilt exciter, two 22·5 kVA "Metro-Vick" and four 28·1 kVA "Crom-Park." Prompt dispatch.—For full details please write: Thos. W. Ward, Ltd., Albion Works, Sheffield. Phone 26311 (ex 347). (C 793)

GENERATOR. 11 kW, 100/145 V, 930 r.p.m., 76 amps; continuous rating, shunt wound. 17 h.p. A.C. MOTOR, slipring, 930 V, 3-ph, 50 c/s.; 440 V; continuous rating; rotor 31 amps; with air starter. Both machines by Crompton Parkinson, on a bedplate, for £70.—Elliman, Sons and Co. Ltd., Slough 22720. (D 669)

DIESEL ALTERNATORS in stock, 1 and 3 phase, standard voltages.—Details post free on request.—Thos. W. Ward Ltd., Albion Works, Sheffield, Tel. 26311 (ex. 347). (C 792)

DIESEL GENERATING PLANT. Several 50 kVA self-contained Cummins/Westinghouse sets, each comprising vert. 6 cyl. engine model H. 600, radiator fan cooled, 1,000 r.p.m., electric start, direct coupled to alternator 400/3/50, 4 wire, with switchboard. Can be supplied stationary or mobile on 4 pneumatic tyred wheels. Prompt delivery. Photographs available.

Several 31 kVA self-contained Cummins/Westinghouse sets, each comprising vert. 6 cyl. engine model A. 1,000 r.p.m., radiator fan cooled, direct coupled to alternator 400/230/3/50, 4 wire, with switchboard. Can be supplied stationary or mobile, mounted on 4 pneumatic-tyred wheels. Prompt delivery. Photographs available.

George Cohen Sons and Co., Ltd., Wood Lane, London W.12. Tel.: Shepherds Bush 2070 and Stanningley, nr. Leeds. Tel.: Pudsey 2241. (E 19)

OFFERS wanted for two redundant E.C.C., 300 V, 50-c/s SINGLE-PHASE ALTERNATOR SETS, 78 kVA and 30 kVA, direct coupled to 460 V d.c. motors.—Le Bas Tube Co., Ltd., Millwall, E.14. (D 700)

THE Electroplant Co., Wembley, for any type of special duty electrical plant. Specialities: CONVERTORS, GENERATING SETS, ELECTRICAL TEST EQUIPMENT. Ask for production range. (D 686)

THREE d.c. GENERATORS connected in one line with couplings or can be separated having their own base. Each 2,200 kW, 400 V, 440/500 r.p.m., 5,500 amps. Delivery immediate: equal to new.—Apply, C. J. Rice, 137 Mayplace Road West, Bexleyheath. Phone: Bexleyheath 3282. (D 546)

100 kVA modern DIESEL ALTERNATOR SET, vert. 6-cyl. cold start diesel engine on baseplate coupled to 400/230 V, 3-phase, 50-cycle, 1,000 r.p.m. alternator. Details on request.—Thos. W. Ward Ltd., Albion Works, Sheffield. Phone 26311 (ex. 347) (C 796)

LIGHTING EQUIPMENT

BENJAMIN 12 in. and 14 in. REFLECTORS, 2,000 available, mostly new, 3s. 6d. each lots of 50.—Boyce-Weir and Co., 46-48 Whiteley Street, Milnsbridge, Huddersfield. Phone: Milnsbridge 516. (D 729)

CANDLE LAMPS, 25 and 40 watts, olive and twisted clear, frosted, and coloured. All caps. Liberal discounts to wholesalers and electrical trade. Wholesalers can have their own name candle lamp which carries a guarantee.—Thos. Handley and Co., Ltd., 74 Wellington Street, Leeds 1. (B 682)

FLOODLIGHTS, Ediswan 1,000 W in perfect condition (11 only) for disposal.—Apply to Bissell, Ltd., 128 High Street, West Bromwich. Tel.: West Bromwich 0216. (E 28)

FUSES, English Electric and Reyrolle H.R.C. at half price. Immediate delivery. Send for lists.—Ryness Ltd., 178 Stamford Hill, London N.16. (D 731)

PURLEY CHOKES AND BALLASTS. Silent operation, excellent performance, efficiency, long life, vacuum impregnated, quick delivery. Low price (e.g. Purley Queen, 80 watts, 14/6 each, less quantity and cash discounts). Quotations for export.—F. W. Blanshard, Ltd. (Dept. ET), Purley, Surrey. (D 623)

METERS

AC/DC. SLOTMETERS (prepayment meters) all types and sizes. We supply Electricity Boards and Govt. Depts., Billiard Switches and Time Switches from stock. If you need reliable instruments write to: Brent Electrical Co., 6 Holmdale Gardens, Hendon, London N.W.4. (A 15)

A.C. and d.c. Quarterly and Prepayment METERS.—Electric Meter Co., Melville Lane, Torquay. (D 734)

HOUSE SERVICE METERS, a.c. or d.c., quarterly or prepayment.—Universal Electrical, 221 City Road, London E.C.1. (C 51)

HOUSE SERVICE METERS, from 5s. Guaranteed two years.—Electric Meter Co., Melville Lane, Torquay. (D 735)

METERS, a.c. and d.c., new and reconditioned, all types, quarterly, single and three phase, 3 and 4 wire, 2½ to 1,000 amps. Prepayment, single and double tariff, single, dual and triple coin, fixed and variable tariff, 2½ to 50 amps. M.D.I., billiards switches, rent collectors. Prices from 5s. carriage paid. Two-year guarantee. Immediate delivery. Illustrated catalogue from The Electric Meter Co., 16 Melville Lane, Torquay. (D 733)

MOTORS & STARTERS

A.A. ELECTRICAL CO. — For A.C./D.C. MOTORS SWITCHGEAR, EXHAUST FANS, HOISTS, REDUCTION GEARS, new or reconditioned units.—Chiswick 5105, Fairlands 8279, 67 Rothschild Road, W.4. (A 19)

A.C. and D.C. MOTORS, all sizes, large stocks, fully guaranteed.—Milo Engineering Works, Ltd., Milo Road, East Dulwich, S.E.22 (Forest Hill 2278-9). (A 10)

ELECTRIC MOTORS, GENERATORS, TRANSFORMERS A.C. & D.C.

STARTERS, SLIP RING & D.C., SEMI-AUTOMATIC

Any voltage, new, short delivery, all types of revolving electrical power.

ELECTROPOWER COMPANY LIMITED

Kingsbury Works, Kingsbury Road, London N.W.9.
Telephone: COLindale 4621/2. (D 17p)

A.C. and d.c. MOTORS, GENERATORS, from stock.—Service Electric Co. Ltd., Honeypot Lane, Stanmore, Middx. Edgware 8631/4. (A 476)

A.C. and D.C. MOTORS, GENERATORS, SWITCHGEAR, etc., always in stock. Let me have your inquiries.—G. E. Whittaker, Wellington Mill, Bolton Road, Blackburn. Tel.: 7232. (A 12)

BRAND new A.C. MOTORS, 1/3 h.p. to 90 h.p., 400/440 V, 3-phase, 50 cycles, 750, 1,000, 1,500 r.p.m. Squirrel cage and slip ring, with or without control gear. Immediate despatch ex stock. Attractive prices. Full details on request.—Thos. W. Ward, Ltd., Albion Works, Sheffield. Phone 26311 (ex. 347). (C 794)

ELECTRIC MOTORS. (2) 60 h.p., 400 V a.c., 980 r.p.m., 50 cycles, 3 phase Squirrel Cage type, ind. closed air circuit, continuously rated, with two endshield bearings including liners. Brand new February, 1950, unused direct from makers. £239 each. Also 2 starters for above motors. Auto-Transformer type. Brand new, as above. £74 each.—Write: Sidney Terry Ltd., 88 St. Dunstan's Street, Canterbury. (E 10)

FOR ELECTRIC MOTORS, GENERATORS, ALTERNATORS, SWITCHGEAR, please send your inquiries to Oldfield Engineering Co., Ltd., 96 East Ordsall Lane, Salford 5. (C 296)

TOTALLY enclosed A.C. MOTORS, new and reconditioned, 1 to 30 h.p., 400/440 V, 3-phase, 50 cycles, 750, 1,000, 1,500 r.p.m. Immediate despatch ex-stock. Attractive prices. Full details on request.—Thos. W. Ward Ltd., Albion Works, Sheffield. Phone 26311 (ex. 347). (C 795)

WE have in stock a wide range of electric MOTORS and STARTERS up to 3 h.p. Reasonable prices. What offers?—John Shaw and Sons (Honley) Ltd., Honley, Huddersfield. Telephone Honley 22 (B 413)

220 H.P. B.T.H. Slip Ring MOTOR, 400/440 V, 3-phase, 50 cycles, 365 r.p.m., on baseplate with O.I. circuit breaker, cont. and res.—Thos. W. Ward Ltd., Albion Works, Sheffield. Phone 26311 (ex. 347). (C 797)

350 H.P. G.E.C. Slip Ring MOTOR, 400 V, 3-phase, 50 cycles, 375 r.p.m., on baseplate with Ellison O.I. starting gear.—Thos. W. Ward Ltd., Albion Works, Sheffield. Phone 26311 (ex. 347). (C 798)

SWITCHGEAR

L.T. CUBICLE TYPE SWITCH by Brush Electrical Engineering Co. Fitted with draw-out type circuit breaker. 1,000/1,600 amp., 400 V, 3-phase, 50 cycles isolator and the following instruments:—Ammeter, power factor meter, integrating K.W.H. meter. The above in excellent condition; as new.—Offers to: Box No. 1839, Electrical Times. (D 619)

MERCURY SWITCHES are made by Hall Drysdale and Co., Ltd., of 58 Commerce Road, Wood Green, London, N.22. Tel.: Bow 7221. (C 175)

TRANSFORMERS & CONVERTORS

ONE Met.-Vick. TRANSFORMER, 6,600/400 V 3-phase, 50 c/s, 150 kVA. One, as above, maker Brush Electrical 11,000/415 V 3-phase 50 c/s, 250 kVA.—Box No. 1021, Electrical Times. (E 26)

UNCLASSIFIED

A.C. and D.C. MOTORS (all ratings) up to 350 h.p. ALTERNATORS, GENERATORS, GENERATING SETS, TRANSFORMERS, WELDING PLANT, PLATING EQUIPMENT, CONTROL GEAR, SWITCHGEAR, PORTABLE ELECTRIC TOOLS, etc.—Write for current electrical stock list, post free.—Thos. W. Ward, Ltd., Albion Works, Sheffield. Tel. 26311 (ex. 347). (C 791)

BUSINESSES FOR SALE

RAMSGATE. RADIO AND ELECTRICAL SALES SERVICE. Turnover £1,400 p.a. Neglected owing to ill health. Flat, d.f. shop, two semi-basement workshops. Freehold, goodwill, fittings and fixtures, £2,200. Plus s.a.v.—Apply Box No. 1883, Electrical Times. (D 739)

MISCELLANEOUS

TO FORMER APPRENTICES OF THE BRUSH ELECTRICAL ENGINEERING COMPANY LIMITED

An Association has been formed and is at present directed by a provisional Committee under the Chairmanship of Mr. J. H. R. Nixon, Technical Director, and a GENERAL MEETING of the Association is to be arranged in London later in the year to elect Officers and Committee, which will be followed by a re-union Dinner.

Will all former Brush Apprentices write to: Mr. K. H. Platt, Chief Education Officer,

THE BRUSH ELECTRICAL ENGINEERING CO., LTD.
LOUGHBOROUGH, ENGLAND

giving full name and address, period when apprenticed at Loughborough, name of present firm and position held. (E 14p)

A.M.I.E.E., City and Guilds, etc., on "NO PASS—NO FEE" terms. Over 95% successes. For full details of modern courses in all branches of Electrical Technology send for our 176-page handbook, FREE and post free. B.I.E.T. (Dept. 39), 17 Stratford Place, London W.1. (D 244)

IT is desired to secure commercial development in the United Kingdom of Br.Pat. No.582281 for an "IMPROVEMENT IN ART OF DIELECTRICS" either by sale or by grant of licences.—Apply Phillips's, 329 High Holborn, London W.C.1. (D 747)

RAMSGATE.—Stay here for your ELECTRICAL TRADES UNION CONFFRENCE. Best position sea front; facing harbour, sands and pier. Hot and cold all bedrooms; Slumberland beds. Comfortable lounge. Excellent food. Full board 3½ gns.—Mrs. A. Owen, "Sea View," Sion Hill. (E 25)

RICHARDS AND PARTNERS, associated with George Offord and Co., Auctioneers and Valuers of PLANT AND MACHINERY AND INDUSTRIAL PROPERTY, Granville House, Arundel Street, London W.C.2. Tel.: TEMple Bar 7471. (A 23)

THE GENERAL ELECTRIC CO., LTD.,
WITTON ENGINEERING WORKS

THE company's register of all ex-apprentices and trainees of the above works is being brought up to date. Any ex-apprentice or trainee who underwent training lasting more than six months at the Witton Works, and is no longer with the G.E.C. organisation, is asked to apply to the Education and Training Officer, G.E.C., Witton, Birmingham 6, for a registration card. (E 23)

INSTRUCTION CHART

For dealing with apparent death from

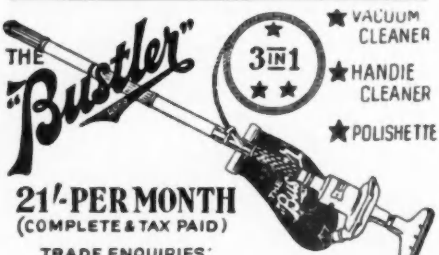
ELECTRIC SHOCK

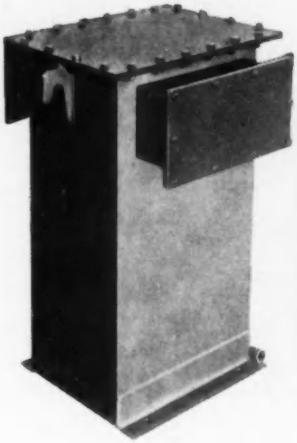
(In accordance with H.O. Electy. Reg. 29)

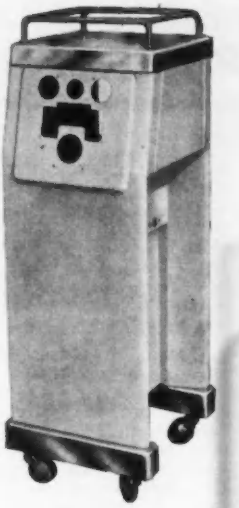
Mounted on strong board, varnished and corded for hanging

ELECTRICAL TIMES

Sardinia House, Sardinia St., LONDON, W.C.2.







THE CASE

for good gear

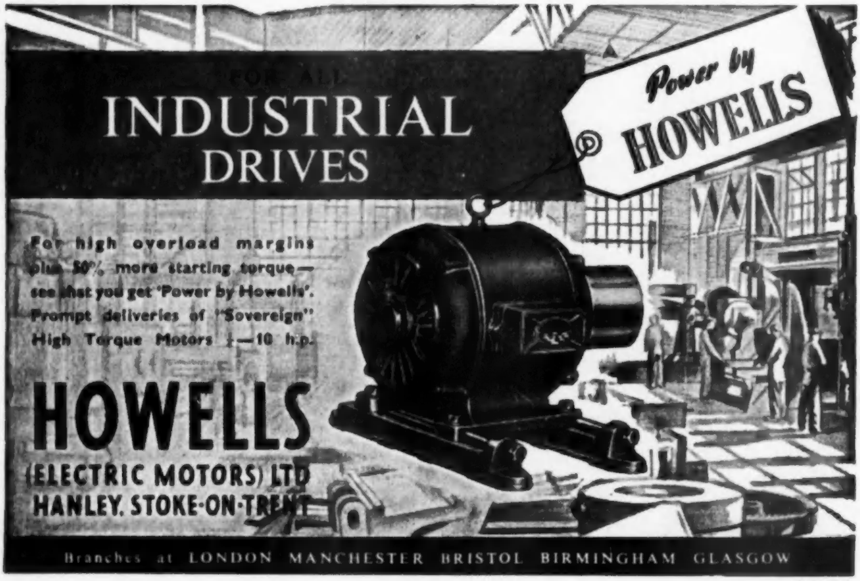
Good equipment deserves good containers. Good functional design and high-class finish of the cover protects the gear and governs the appearance of the appliance or installation. Industrial and private buyers at home and abroad are paying increasing attention to the quality and finish of the case or cover when selecting equipment.

Sign and Metal Industries Ltd. make all kinds of metal work for engineering products, particularly for electrical gear. Containers are supplied with any desired degree of finish and include, for example, completely finished coloured covers for small and portable units, motor and transformer casings, trolleys and cases for control gear, instruments and electro-medical equipment, and many others. Specialists in the supply of aluminium partitioning and panelling.

SMI *SIGN AND METAL INDUSTRIES LTD.*
STOCKINGSWATER LANE, ENFIELD, MIDDX. TELEPHONE: HOWARD 2674

INDEX TO ADVERTISERS

Aberdare Cables, Ltd. ... 74
Allied Ironfounders, Ltd. ... 34
Arora Co., Ltd. ... 56
Ash and Lacy, Ltd. ... 28
Auto. Light Controlling Co., Ltd. 62
Bestfrend Electrical Co., Ltd. ... 62
Best Products, Ltd. ... 64
Brit. Celanese, Ltd. ... 24
Brit. Central Elec. Co., Ltd. ... 11
Brit. Driver-Harris Co., Ltd. ... 20
Brit. Ins. Callender's Cable Co., Ltd. ... 15
Brit. Thomson-Houston Co., Ltd. 1, 5
Brit. Vacuum Cleaner & Engrg. Co., Ltd. ... 55
Brook Motors, Ltd. ... 41
Brush Elec. Engrg. Co., Ltd. ... 26
Bulpitt and Sons, Ltd. ... 42
Burco, Ltd. ... 40
Cable Makers Association ... 39
Carron Company ... 30
Copper Development Association 14
Cressall Mfg. Co., Ltd. ... 4
Crompton Parkinson Ltd. 2, 21
Crypton Equipment, Ltd. ... 23
Dapag (1943), Ltd. ... 66
Dorman and Smith, Ltd. ... 38
Dubilier Condenser Co. (1925), Ltd. ... 71
East London Mica Works ... 62
Edwards, F. J., Ltd. ... 70
Eeto Insulations ... 68
E.M.B. Co., Ltd. ... 4
Enfield Cables, Ltd. ... 19
English Electric Co., Ltd. ... 13
Ferranti, Ltd. ... 8
Fluxite, Ltd. ... 28
General Electric Co., Ltd. 44, 63
Genristo, Ltd. ... 56
Green, E., and Sons, Ltd. ... 65
Grimmer, W. H. ... 66
Grubb Engineering Co., Ltd. ... 64
Hardy and Padmore, Ltd. ... 36
Henley's, W. T. Telegraph Works, Co., Ltd. ... 28, 45
Higgs Motors, Ltd. ... 10
Horstmann Gear Co., Ltd. ... 38
Howells Electric Motors ... 54
Igranic Electric Co., Ltd. ... 36
International Combustion, Ltd. 22
Johnson and Phillips, Ltd. 29, 59
Jones, Samuel and Co., Ltd. ... 66
Kaye, E. and E., Ltd. ... 70
Lancashire Dynamo and Crypto, Ltd. ... 18
Londex, Ltd. ... 70
Lyons, Claude, Ltd. ... 68
Mather and Platt, Ltd. ... 60
Metafiltration Co., Ltd. ... 32
Metro-Vickers Elec. Co., Ltd. 37, 61
Metway Elec. Industries, Ltd. ... 12
Midland Electric Mfg. Co., Ltd. 57
Mole, M. and Son, Ltd. ... 58
Nife Batteries, Ltd. ... 3
Oldfield Engineering Co., Ltd. ... 70
Omega Lampworks, Ltd. ... 66
Parmiter, Hope and Sugden, Ltd. 73
Pitman, Sir Isaac and Sons, Ltd. 64
Pyrotenax, Ltd. ... 7
Radiovisor Parent, Ltd. ... 20
Record Electrical Co., Ltd. ... 31
Revo Electric Co., Ltd. ... 9
Reyrolle, A. and Co., Ltd. ... 17
Runbaken, Ltd. ... 70
Sanders, Wm., & Co. (Wednesbury), Ltd. ... 56
Sangamo Weston, Ltd. ... 46
Scholes, Geo. H. and Co., Ltd. 32
Senior Economisers, Ltd. ... 72
Serck Tubes, Ltd. ... 16
Siemens Elec. Lamps and Supplies, Ltd. ... 33
Sign and Metal Industries, Ltd. ... 53
Simmonds and Stokes, Ltd. ... 58
Smith, Frederick and Co. ... 69
Steatite and Porcelain Products, Ltd. ... 60
Taylor Tunnicliff and Co., Ltd. 35
Thorn Elec. Industries, Ltd. ... 67
Time Switches and Instruments, Ltd. ... 16
T.M.C. Harwell (Sales), Ltd. ... 25
Tudor Accumulator Co., Ltd. ... 6
Vacuums, Ltd. ... 52
Walter, D. and Co., Ltd. ... 4
Westinghouse B. and S. Co., Ltd. 27
Wootton and Co., Ltd. ... 68
Worthington Simpson, Ltd. ... 12
Yarrow and Co., Ltd. ... 62



FOR ALL
INDUSTRIAL DRIVES

For high overload margins plus 50% more starting torque—see that you get 'Power by Howells'. Prompt deliveries of "Sovereign" High Torque Motors ¼—10 h.p.

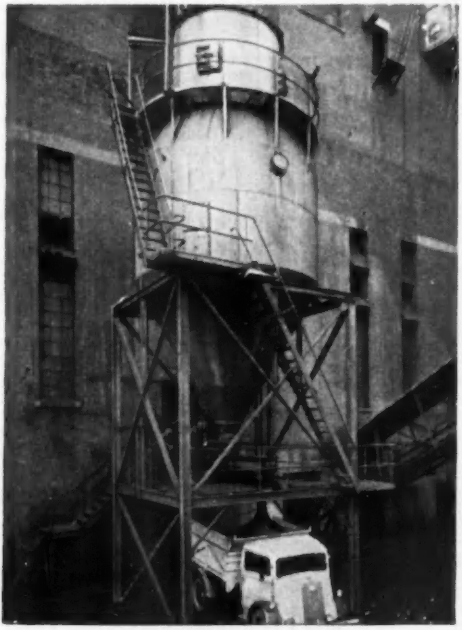
HOWELLS
(ELECTRIC MOTORS) LTD
HANLEY, STOKE-ON-TRENT

Branches at LONDON MANCHESTER BRISTOL BIRMINGHAM GLASGOW

dmHE37

SAVE COST
with-
B.V.C

FLUE DUST AND RIDDLINGS
EXTRACTION PLANT



● The Nation's need demands that Coal shall convert every possible fraction of its energy into power for production. The vital contribution that efficient combustion makes to this end is immeasurably facilitated by B.V.C. Flue Dust Removal Plant. This is the recognised method of keeping steam boilers free from accumulations of flue dust, and ensuring that every ton of coal is used to the best possible advantage by removing and consuming the riddlings.

For Information and Consultation write to Dept. 14

B.V.C. INDUSTRIAL CONSTRUCTIONS LTD
(Subsidiary of the British Vacuum Cleaner and Engineering Co., Ltd)
Africa House, Kingsway, London W.C.2. Tel.: HOLborn 7151. Head Office: Leatherhead, Surrey.

"Elementary
My dear Watson"
GENRISTO

GENRISTO LTD

If you want the best Elements, specify "Genristo." And a most useful first step is to send for the "Genristo" Catalogue, a handsome and useful booklet. Enquiries on business letter headings only.

OSMASTON STREET, NOTTINGHAM

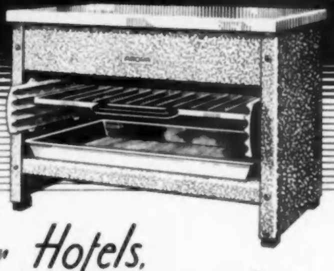
THE UNBREAKABLE PLUG

Nearly eighteen months of experiment was undertaken before the Sanders Unbreakable Plug (for use with Sockets to B.S.546 dimensions) was passed by its designers as fit for the onerous duties for which it was created. Today the phenomenal demand for it remains unassailed though inevitably challenged by copyists, unexperienced in the essentials of pioneering.

SANDERS
WEDNESBURY

WEDNESBURY · STAFFS · ENGLAND

'ARORA' electric
heavy duty
TOASTERS & GRILLERS



for Hotels,
Restaurants & Canteens.

SEND FOR LEAFLET C482

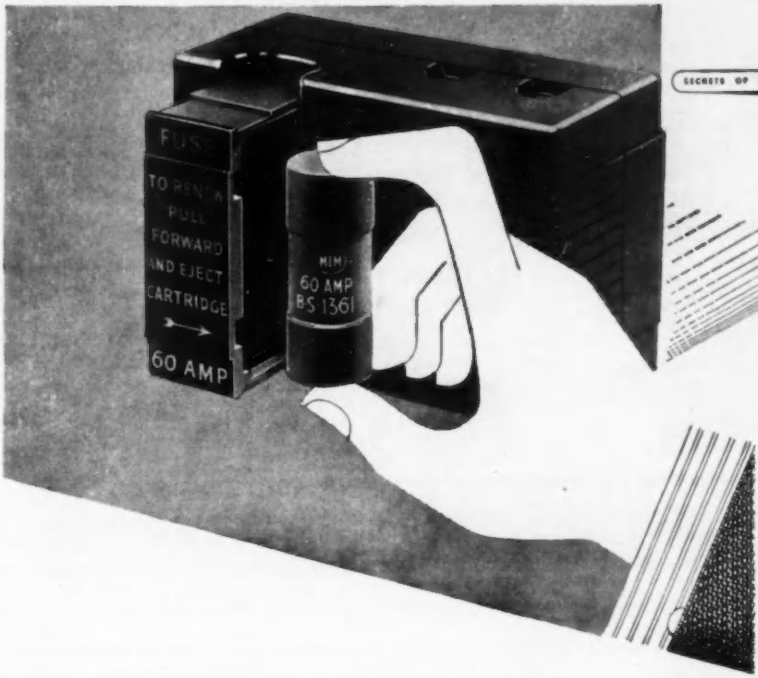
The ARORA Company

ROSEBERY STREET, LOUGHBOROUGH

Specialists for over 30 years

109

SECRETS OF SWITCHCRAFT



Quick fuse renewal–with *Safety*
Quick delivery–with *Certainty*

Here's a new point in favour of the Mem-ac. You can get it now on quick delivery. Big increases in factory output in recent months have made this possible.

Anyone who can switch on a light can renew the fuse in the MEM-AC switch-fuse. It takes just 5 seconds, requires no tools and is absolutely safe. Contact with live parts is impossible. The whole unit takes up less than half the space of conventional equipment. It is a fine example of what MEM switchcraft can do.

MEM

Switch, fuse and motor control gear, electric fires and localised lighting equipment

MEM-AC is made in two sizes for 30 and 60 amps 250 volts, double pole with three fuse ratings 15, 30 and 60 amps for AC only. Spare fuses available to meet all needs.

MIDLAND ELECTRIC MANUFACTURING CO. LTD., BIRMINGHAM 11.
Branches in London and Manchester

REGD TRADE MARK **NIPHAN** WEATHERPROOF METAL-CLAD PLUGS, SOCKETS, SWITCH PLUGS, ETC. for all electrical purposes

5/300 amp. 250/500 volt.

Plug
Through Angle Socket with Cover and Plug
C.I. Terminal Socket & Cover with through sealing chamber and glands for cable
Plug
C.I. Switch Socket and Plug
Flange Socket and Cover

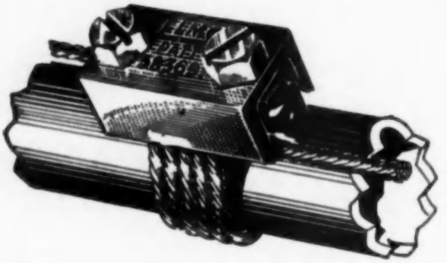
(Latest Catalo ue on Application)

SIMMONDS & STOKES LIMITED

MANUFACTURING ELECTRICAL ENGINEERS

Victoria House, Southampton Row, London, W.C.1 · Holborn 8637 and 2163

OVERSEAS AGENTS: *S. AFRICA, Hubert Davies & Co., Ltd., Johannesburg. NEW ZEALAND, Samuel Brown, Ltd., Wellington. INDIA, G.E.C. (India) Ltd., Calcutta. CEYLON, Walker & Greig, Ltd., Colombo.*



SAFE *and* SECURED

TO B.S. 951-1948 for

B.S. CONDUIT SIZES 1-3

The Elmo Earthing Clip is of robust construction, having larger surface than any other. Impossible for wire to pull out, always under tension, therefore the perfect earth and a permanent safeguard.

Obtainable through all leading wholesalers.

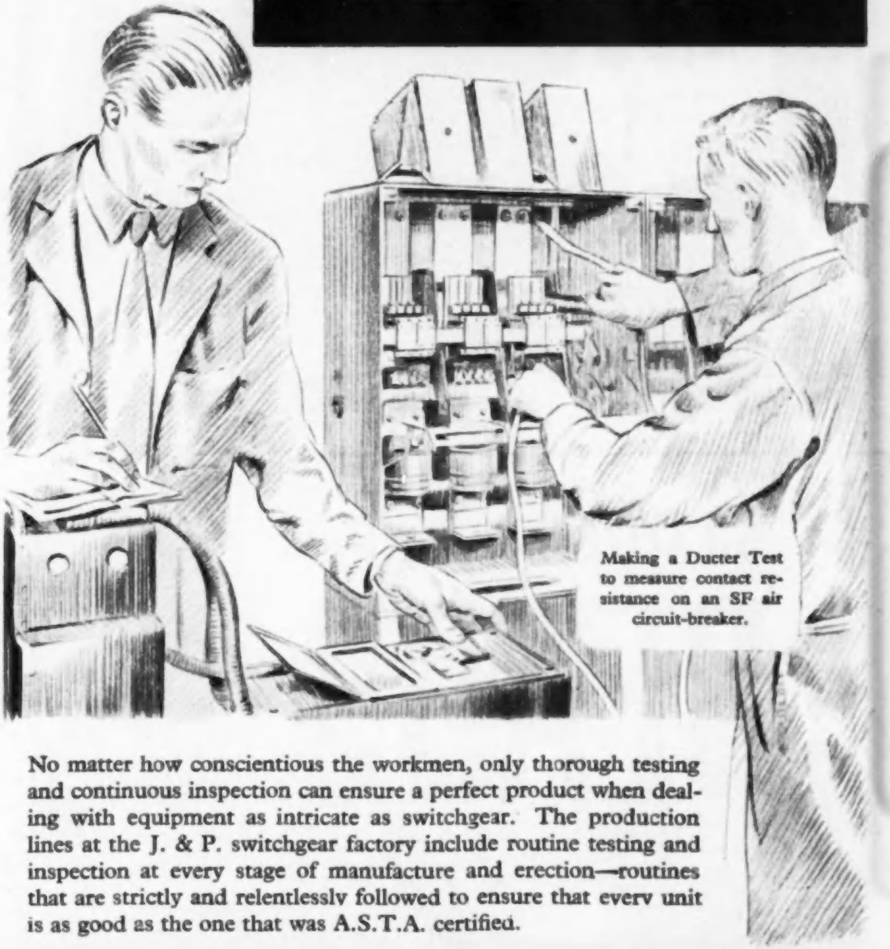
"ELMO" EARTHING CLIP

The CLIP with a GRIP!

Write for samples to-M. MOLE & SON LTD. 51-56. CHARLOTTE ST. BIRMINGHAM 3

ENSURING
THAT 'LITTLE MORE' IN QUALITY

in J.&P. *SWITCHGEAR*



Making a Ducter Test to measure contact resistance on an SF air circuit-breaker.

No matter how conscientious the workmen, only thorough testing and continuous inspection can ensure a perfect product when dealing with equipment as intricate as switchgear. The production lines at the J. & P. switchgear factory include routine testing and inspection at every stage of manufacture and erection—routines that are strictly and relentlesslv followed to ensure that everv unit is as good as the one that was A.S.T.A. certified.

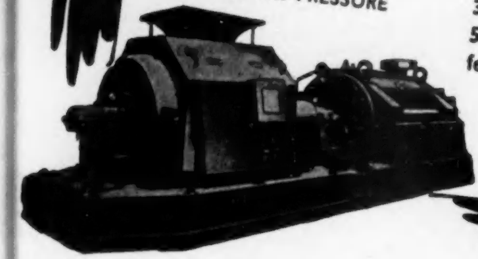
JOHNSON & PHILLIPS LTD.
CHARLTON LONDON S.E.7
The mark that means that "little more" in quality

MATHER & PLATT LTD.
PARK WORKS. MANCHESTER 10.

3,000

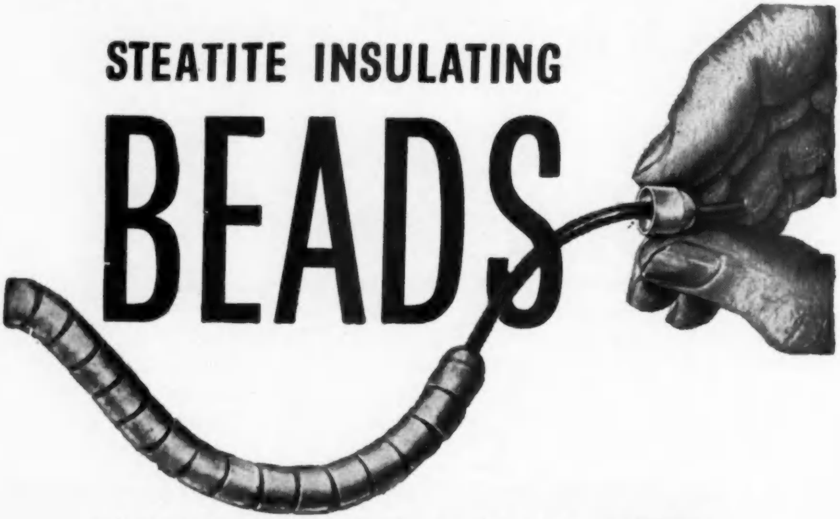
H.P. VOLTS
R.P.M.
LB. PER SQ. IN. PRESSURE

This 3000 B.H.P., 3000 Volt, 3000 R.P.M. Squirrel cage motor, when started by switching direct-on to the supply mains, takes not more than 4½ times full load current. It drives an M. & P. Boiler Feed Pump operating at a pressure of 3000 lb. per sq. inch and delivering 520,000 lb. of high temperature boiler feed water per hour.



STEATITE INSULATING

BEADS

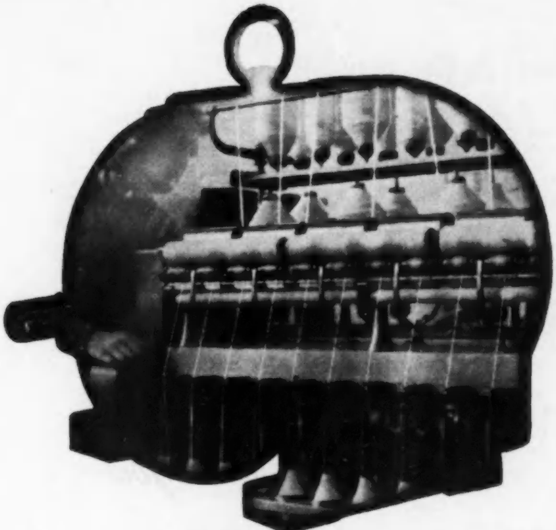


S.P. Insulating Beads are extremely strong and fully vitrified, yet very low in price. They are now available from stock. Sizes for wire 4-18 S.W.G.

STEATITE & PORCELAIN PRODUCTS LTD.

Stourport-on-Severn   Tel: Stourport 111.   Grams: Steatain, Stourport

S.P.83



IN THE
TEXTILE WORLD
THEY SAY . . .

"That's good, it's an M-V Motor"

Naturally, an M-V motor will do all that the specification calls for, but M-V reliability goes beyond the specification. It's built into the machine—it's part of the M-V reputation. Further, the Metrovick service gives you the advice of specialist engineers who really understand the electrical problems of many industries from textile mills to oil refining units. Whether the need is for a fractional or a 1,000 H.P. machine, the user realises that you are giving him the best when you specify Metrovick.

The METROVICK range of motors covers every requirement of the textile industry. The motor illustrated is a type KZ smooth acceleration 8 H.P. totally enclosed fan-cooled squirrel cage machine. Among its many applications is the driving of ring spinning frames and it is designed to ensure trouble-free service under all conditions.

METROPOLITAN-VICKERS ELECTRICAL CO. LTD. · TRAFFORD PARK · MANCHESTER · 17

METROVICK *Motors for all Industrial Drives*

J/A001

WATER TUBE BOILERS

YARROW & CO. LTD.

Telegrams:
"YARROW, GLASGOW"
Telephone:
SCOTSTOUN 2228

Scotstoun,
Glasgow, W4

BESTFREND
TUBULAR
SHEATHED ELEMENTS

Manufacturers and designers interested in Domestic or Industrial heating *OF ANY DESCRIPTION* assured of enthusiastic co-operation. Reliable elements of any shape or loading for any purpose.

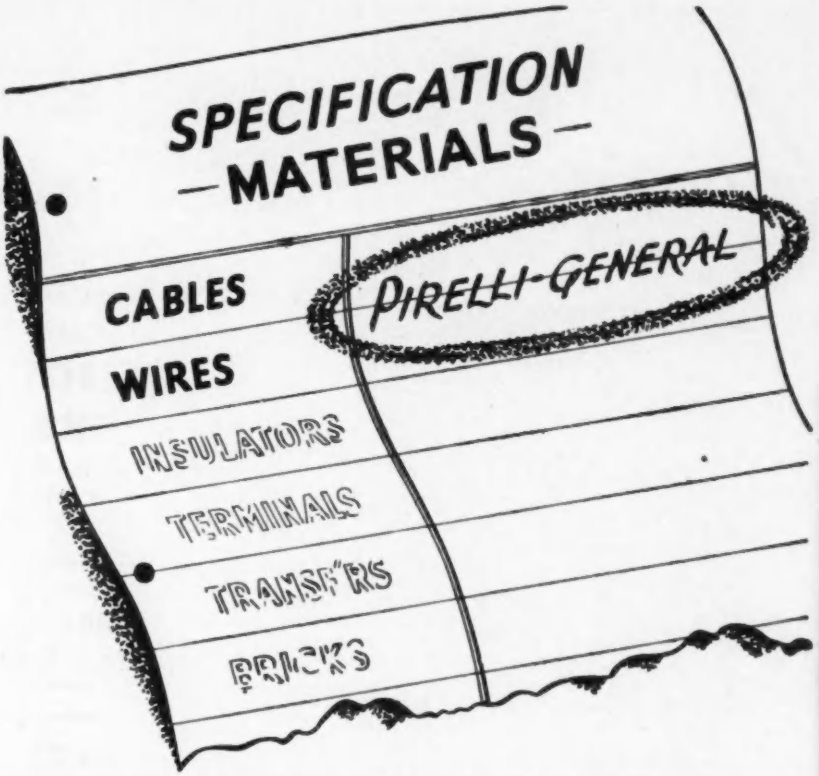
The BESTFREND ELECTRICAL Co. Ltd.
Diceland Wks. Banstead. *Phone: Burgh Heath 1432*

USE "GUNFIRE"
TRADE MARK
Time Switches
AND
Process Timers
FOR SATISFACTION
AUTOMATIC LIGHT CONTROLLING CO. LTD.,
BOURNEMOUTH
Established over Fifty Years.

EAST LONDON MICA WORKS
(*Est.* 1912)
Manufacturers of :—

MICA		MICANITE		BAKELITE
Washers Plates Commutator Segments Stampings Stove Plates Heater Strips, etc.	★	Mouldings, Commutator Vee Rings, Tubes, Covered Bars, Commutator Segments, Heater Strips. Sheet Material in Moulding, Flexible, Heat Resisting and Commutator Qualities, etc.	★	Tubes Bushes, Bobbins Washers Stampings Panels Covered Bars, etc.

RINGWOOD ROAD, WALTHAMSTOW, LONDON, E.17
'Phone: KEYstone 4254. *Telegrams: Elmicmer, Easphone, London*


SPECIFICATION
—MATERIALS—
CABLES
WIRES
INSULATORS
TERMINALS
TRANSF'RS
BRICKS
PIRELLI-GENERAL

Put PIRELLI GENERAL Cables here..

Whether your need is for conductors that will carry fractions of an amp., or amps., measured by the thousand and whatever the working conditions of the circuit, there are wires and cables in the Pirelli-General range that will best suit your requirements.

Many years of wide experience and research have resulted in the manufacture of these high quality cables which will give long, trouble-free service.

GET IT FROM THE
G.E.C.

PIRELLI GENERAL
Cables

The General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.

PREPARING COFFEE
AND MAKING TEA
ONLY THE Best
WILL DO FOR ME!

That's what a lot of modern women say about these fine British electric helps for the home. This **"BEST" COFFEE PERCOLATOR** has a 2½ pint capacity, almost instant percolation, a special "keep hot" device and an automatic safety cut-out for the heater. Made of heavy gauge copper, finished in polished chrome. Loading 500 watts—A/C only.

THE "BEST" KETTLE holds 3½ pints, and has an automatic safety Connector-Ejector element. Polished nickel plate or chromium on solid copper. Loading 1250 watts, for 100/120, 200/220 and 230/250 volts. A.C./D.C.

SPARE ELEMENTS Non-Automatic and Automatic Safety Connector-Ejector types are available in two sizes; 700 watts for 2-pint kettles, and 1250 watts for 3½, 4 or 6-pint kettles. Automatic thermostatic elements also available, also higher loadings if required.

"BEST" ELECTRIC JUGS are of graceful design with chromium-plated repoussé finish on solid copper. Three insulated feet. Capacity 2 pints (700 watts) or 4 pints (1250 watts), voltages as above.

D6

Best Products Ltd

FELIX WORKS, FELIXSTOWE, SUFFOLK
Phone: 554 Felixstowe. Grams: Best, Felixstowe

The
GRUBB
ALL-ELECTRIC
THERMOSTATICALLY
CONTROLLED
**IMMERSION
HEATERS**

are fully guaranteed for TWO years. We shall be pleased to quote for your Industrial, Domestic and general heating requirements. Write for trade terms to the sole manufacturers

GRUBB ENGINEERING CO., LTD.
MARY ST., BIRMINGHAM, 12

Pitman

Electric Cables

By Francis W. Main, M.I.E.E. A guide to the properties, construction, installation and maintenance of electric cables. Third Edition. 52 illustrations. 12/6 net.

Principles of Electrical Deposition

By Samuel Field, A.R.C.Sc. The Second Edition of a standard manual, giving the results of recent researches and their practical applications. Illustrated. 20/- net.

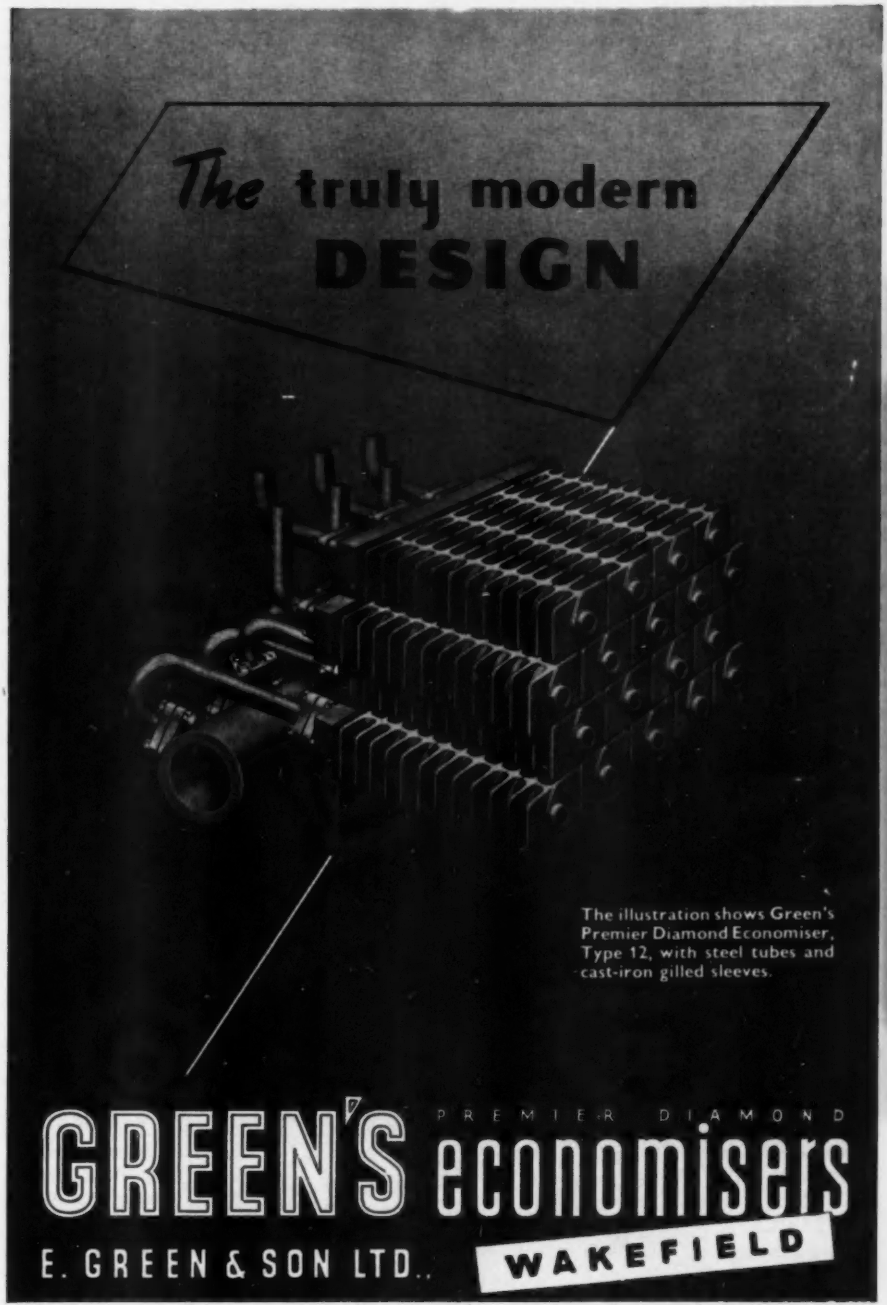
Thermodynamics Applied to Heat Engines

By E. H. Lewitt, Ph.D., B.Sc., A.M.I.Mech.E. A well-known textbook covering the syllabuses of the B.Sc. (Eng.) and I.Mech.E. examinations in this subject. Fourth Edition. 295 illustrations. 30/- net.

The Principles of Television Reception

By A. W. Keen, M.I.R.E., A.M.Brit.I.R.E. A systematic treatment including a stage-by-stage examination of the receiver, and a review of the problem of natural-colour television. Illustrated. 25/- net.

Pitman



The truly modern
DESIGN

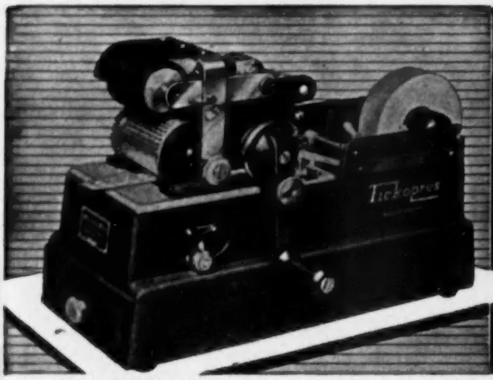
The illustration shows Green's Premier Diamond Economiser, Type 12, with steel tubes and cast-iron gilled sleeves.

GREEN'S PREMIER DIAMOND economisers

E. GREEN & SON LTD., WAKEFIELD

Makers of economisers for one hundred years

GE58



Your overprinting problems end...

WHEN YOU INVEST IN A

'TICKOPRES'

NO MORE RUBBER STAMPS - NO MORE HANDWRITING - NO MORE WAITING FOR THE PRINTER

Any girl or boy in your factory using the TICKOPRES printing machine can overprint all the details on to any quantity of your box ends, labels, tickets, tags, rolls of perforated tickets, etc. Every turn of the handle produces a completed ticket or label.

★ *Free test offer* *Slip a dozen of each of your tickets and labels into an envelope with details you would like overprinted. One of our girls will overprint them for you.*

You will be Amazed at the Results

DAPAG (1943) LTD., DEPT. E.T. 23,
HOLBORN VIADUCT, LONDON,
E.C.1 *'Phone : CITY 5373-4*

Dapag
(1943) LTD

OMEGA GLOW SWITCHES

- Tested to strike at 180 volts.
- For 30, 40, or 80W installations.
- Special terms to fittings manufacturers.

Write for details to :—

Omega Lampworks Ltd., Merton, London, S.W.19

VARNISHED SLEEVINGS IN COTTON, SILK AND GLASS

INSULATING MATERIALS

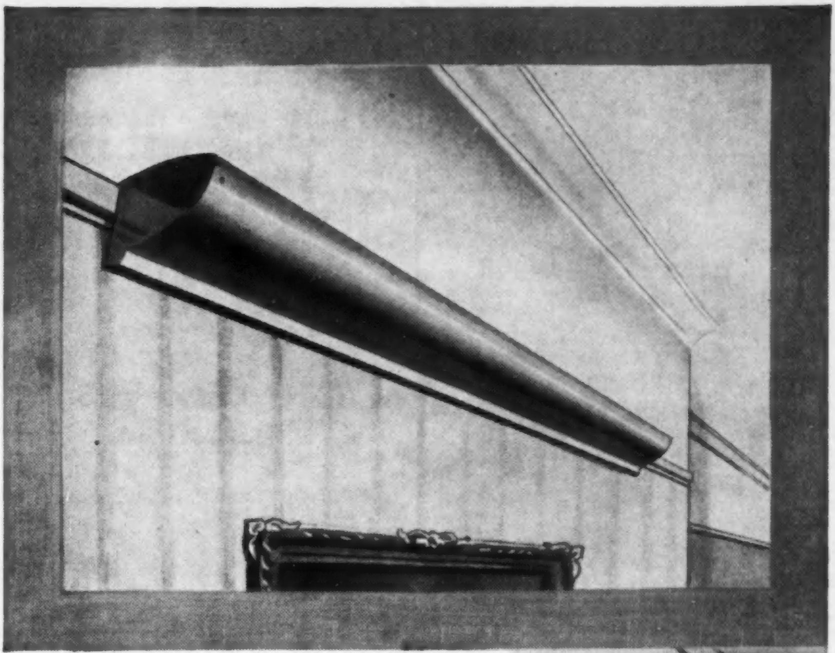
LAMINATED BAKELITE TUBES AND FORMERS

W. H. GRIMMER
50, BOW LANE, CHEAPSIDE, LONDON, E.C.4.
CITY 1791/2 CABLES—CHARTIMER LONDON

IMMEDIATE STOCK SERVICE
in a wide range of widths

★ SELF AI
PAPEF
SAMUEL JO
NEW BRIDGE STREET LO
★ SELF ADHESIVE CLOTH TAPE ★
SAMUEL JONES & CO LTD
NEW BRIDGE STREET LONDON E C 4 CENtral 6500

QUALITY PRODUCTS
regularly used by all leading manufacturers



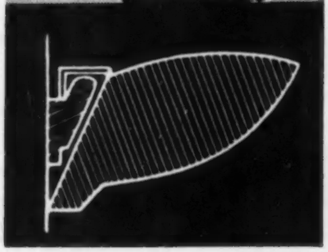
Something entirely new in Fluorescent!

Indirect Cornice Lighting for the Home

THE NEW ATLAS GH/0040 HOME UNIT—ONLY £2 - 19 - 0

plus 9/3d. purchase tax

SO SIMPLE TO FIT!



This ATLAS GH/0040 Home Unit is entirely new and revolutionary. It introduces into the average home, at small outlay, the advantages of soft, indirect fluorescent lighting. It has a 4-ft. tube and reflector, ballasts that ensure noiseless functioning, a two-pin glow starter and special suppressor condenser that eliminates interference with radio reception. This fitting weighs only 7½ lb. and is merely hooked on to the picture-rail. To ensure early supplies and take full advantage of the vast new market this ATLAS fitting creates, please communicate with us *now*.

210

FOR STAYING POWER

ATLAS FLUORESCENT

COMMERCIAL, INDUSTRIAL AND DOMESTIC

THORN ELECTRICAL INDUSTRIES LIMITED, 105-9 JUDD STREET, LONDON, W.C.1. PHONE: EUSTON 1183

NOW—Improved Deliveries on all

VARIAC

Transformers

A three-fold expansion in the rate of production of all Variac models from 50 watts to 7 kilowatts rating, coupled with improved deliveries of lamination steel, castings, mouldings and wires, now enables us to offer nearly all VARIAC Transformers "off the shelf." Most types can be furnished in parallel assemblies, or in 3-gang for 3-phase operation. Usual winding is 230 volt input (tap at 115 volt), 50 cycles, 1 phase; output is usually from 0-230 volt and/or 0-270 volt.

Send for Catalogue V549 today.

36 pages, profusely illustrated, containing complete data with dimensioned drawings of all Variac models.

Prices, circuits and special applications, etc., etc.

Claude Lyons Ltd

ELECTRICAL AND RADIO LABORATORY APPARATUS ETC.

180 Tottenham Court Road, London, W.1, and 76 Oldhall Street, Liverpool 3, Lancs.

METER BOARDS

SWITCH BLOCKS

SUNK SWITCH BOXES

- *FIRST CLASS WORK*
- *QUICK DELIVERIES*
- *COMPETITIVE PRICES*

WE INVITE YOUR ENQUIRIES

We have been making and supplying the Electrical Industry with the above Specialities for over 27 years

WOOTTON & CO. LTD.

ALMA WORKS, PONDERS END, MIDDX.

TELEPHONE: HOWARD 1858

SAVE FUEL COSTS

Patent No. 3284/2

with the

"EETO" CYLINDER JACKET.

Made in sections. Connectingpipes offer no difficulty. **EETO** jackets considerably increase hot water supply with less fuel.

Used in large numbers by Heating Engineers for Housing Schemes, and extensively in conjunction with Immersion Heaters, etc. **EETO** jackets are also made for Horizontal cylinders, square and rectangular tanks.

- **Enormous reduction in heat losses**
- **Finest Insulating Materials only**

Sole Makers:

EETO INSULATIONS

River Street, BOLTON

INCORPORATED IN THE LONDON ELECTRIC WIRE COMPANY AND SMITHS LIMITED

FS
& CO

THIS MARK IS YOUR GUARANTEE OF A GOOD QUALITY PRODUCT

BARE COPPER, CADMIUM COPPER & BRONZE · WIRES STRIP, STRAND, BARS, RODS, SECTIONS, TROLLEY WIRE, OVERHEAD LINES, TELEPHONE & TELEGRAPH WIRES, FINE WIRES, RADIO AERIAL WIRE, TAPES & BINDERS · COMMUTATOR COPPER, COPPER FORGINGS, FUSE WIRES, EARTH RODS, RAIL BONDS, ETC.

FREDERICK SMITH & CO.,
(Incorporated in The London Electric Wire Company and Smith's Limited)
ANACONDA WORKS, SALFORD, 3 LANCS
Telephone: BLACKFRIARS 8701 (8 Lines) *Telegrams: ANACONDA MANCHESTER*

LIGHT
K
ALLOYS

Available NOW

AT AN ECONOMICAL PRICE

Not only a high grade tubing at a competitive price but a great time-saver in conduit installation — "K" Aluminium Electrical Conduit Tubing. Easy to bend, to thread and to set. Quick to cut. Lighter to handle. Will not rust, meaning longer life for tubing and cable. Besides being a good thermal and electrical conductor it is non-magnetic and of attractive appearance.

Available in all the usual conduit sizes, in aluminium or—for extra strength—in aluminium alloy. Supplied with plain ends or screwed with couplings. Let us quote for your requirements.

Aluminium CONDUIT TUBING

E. & E. KAYE LTD.
PONDERS END · ENFIELD · MIDDLESEX

Telephone.
Howard 1601
Telegrams..
Cuwire, Enfield

NEW SMALL PROCESS TIMERS
$5\frac{3}{4}'' \times 6'' \times 5\frac{1}{4}''$

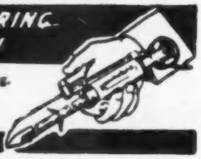
For flush or wall mounting.
Type JPS. Hand Resetting Timer.
Type SRJ. Automatically Resetting Timer.
BOTH SYNCHRONOUS

JPS. *Ask for Lists* 120 & 121/ET

LONDEX LTD
Manufacturers of Relays
207, ANERLEY RD., LONDON, S.E.20. SYDenham 6258-9

For new and used machine tools . . . power presses . . . sheet metal working and woodworking machinery, etc. . . . **F. J. EDWARDS, LIMITED,** 359-61, *Euston Road, London, N.W.*1. *Tel: Euston* 4681-3771. *'Grams: Bescotools Norwest London*

Autofeed SOLDERING IRON



Simple self-feed speeds up soldering. Better work. Saves solder. Write for interesting booklet—26 J

RUNBAKEN MANCHESTER 1

ALL CLASSES OF ELECTRICAL
REPAIRS
REWINDS

A.C. & D.C.
MOTORS
GENERATORS
RECONDITIONED
SWITCHGEAR
etc.
etc.

OLDFIELD ENGINEERING CO. LTD.
96 EAST ORDSALL LANE, SALFORD 5
BLA 2842-3 (2 lines)

Fluorescent
Neon
Gaseous Discharge
DUBILIER NITROGOL CAPACITOR
DUBILIER NITROGOL CAPACITOR

Improve

THE POWER FACTOR

Available in a wide range of sizes and shapes, Dubilier Fluorescent Capacitors are made on the 'Nitrogol' principle, and comprise elements of multi-paper dielectric construction using aluminium foil electrodes, assembled in crimp seamed and solder sealed containers — this special construction ensures complete hermetic sealing and reliable operation in all atmospheric conditions. Their small size, convenient form, and variety of fixing arrangements, enable Dubilier Capacitors to be readily incorporated in all types of lamp fittings. In addition a comprehensive range of complete suppressor units is available.

DUBILIER
CONDENSER CO. (1925) LTD.
CAPACITORS

Full technical details supplied upon request.

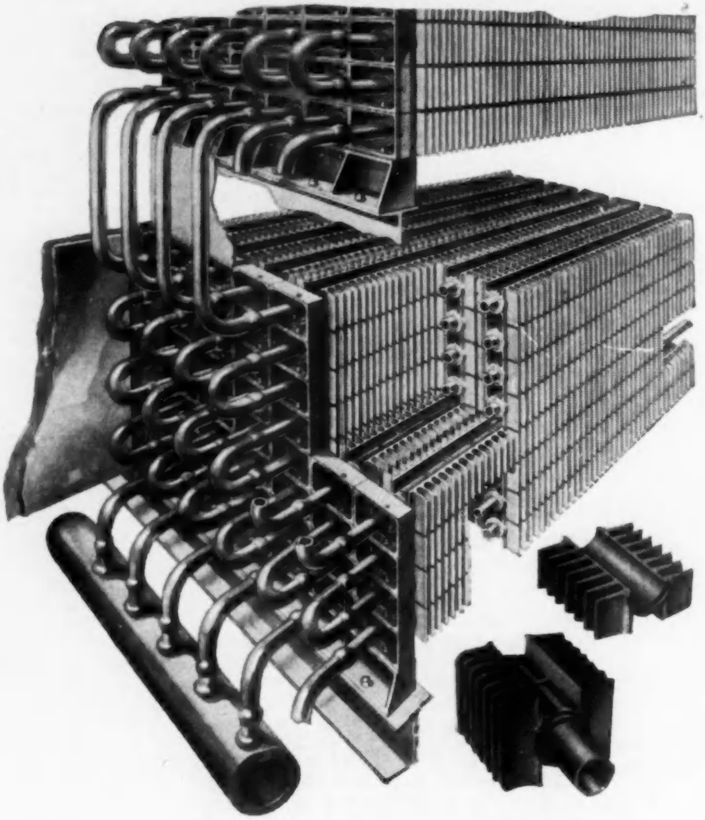
MAKERS OF THE WORLD'S FINEST CAPACITORS

DUBILIER CONDENSER CO. (1925) LTD., DUCON WORKS, VICTORIA ROAD, NORTH ACTON, W.3
'Phone: Acorn 2241 (5 lines) 'Grams: Hilvoltcon, Phone London Cables: Hilvoltcon, London Marconi International Code

D23

SENIOR ECONOMISERS

WELDED TYPE FOR CENTRAL POWER STATIONS



Showing construction of
Tube Elements

The all-welded Senior Economiser was developed to meet the conditions of extra high working pressures up to and above 2,000 lb. per sq. in. Such installations have been in operation since 1938, with complete satisfaction. The advantages of the all-welded type are now being appreciated for much lower pressures.

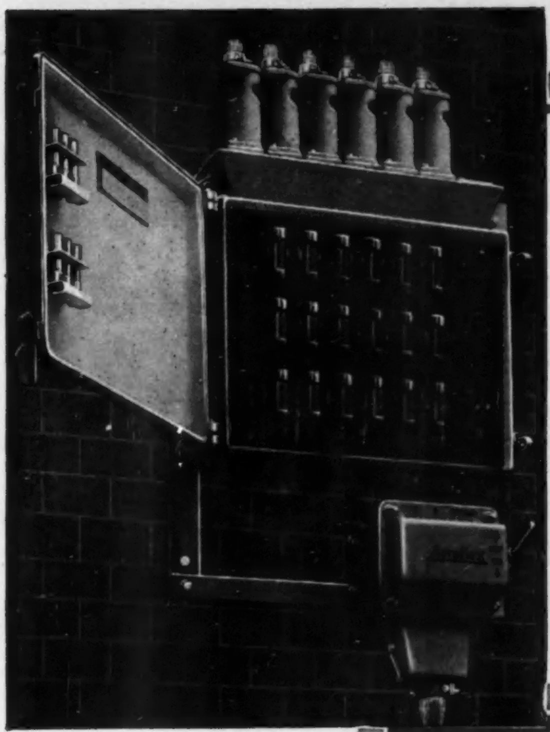
The tube elements consist of cold-drawn seamless steel tubes, on to which are shrunk cast-iron sleeves with the characteristic Senior H-type gills.

SENIOR ECONOMISERS LTD., 11 SOUTHAMPTON ROW, LONDON, W.C.1

Printed in England for the Proprietors, The Electrical Times, Ltd., by Sun Printers, Ltd., London and Watford, Herts., and published at Sardinia House, Sardinia Street, Kingsway, London, W.C.2. March 2, 1950.

Ironclad

DISTRIBUTION FUSEBOARDS



These Multiway Fuse Boards are constructed of cast iron and are entirely suitable for arduous conditions of service ; they incorporate removable troughs or steel top and bottom plates thereby facilitating drilling and cabling.

The extensive range comprises both watertight and dust excluding Distribution Fuse Boards covering large and small capacities, each incorporating Aeroflex High-breaking capacity rewireable cartridge fuses.

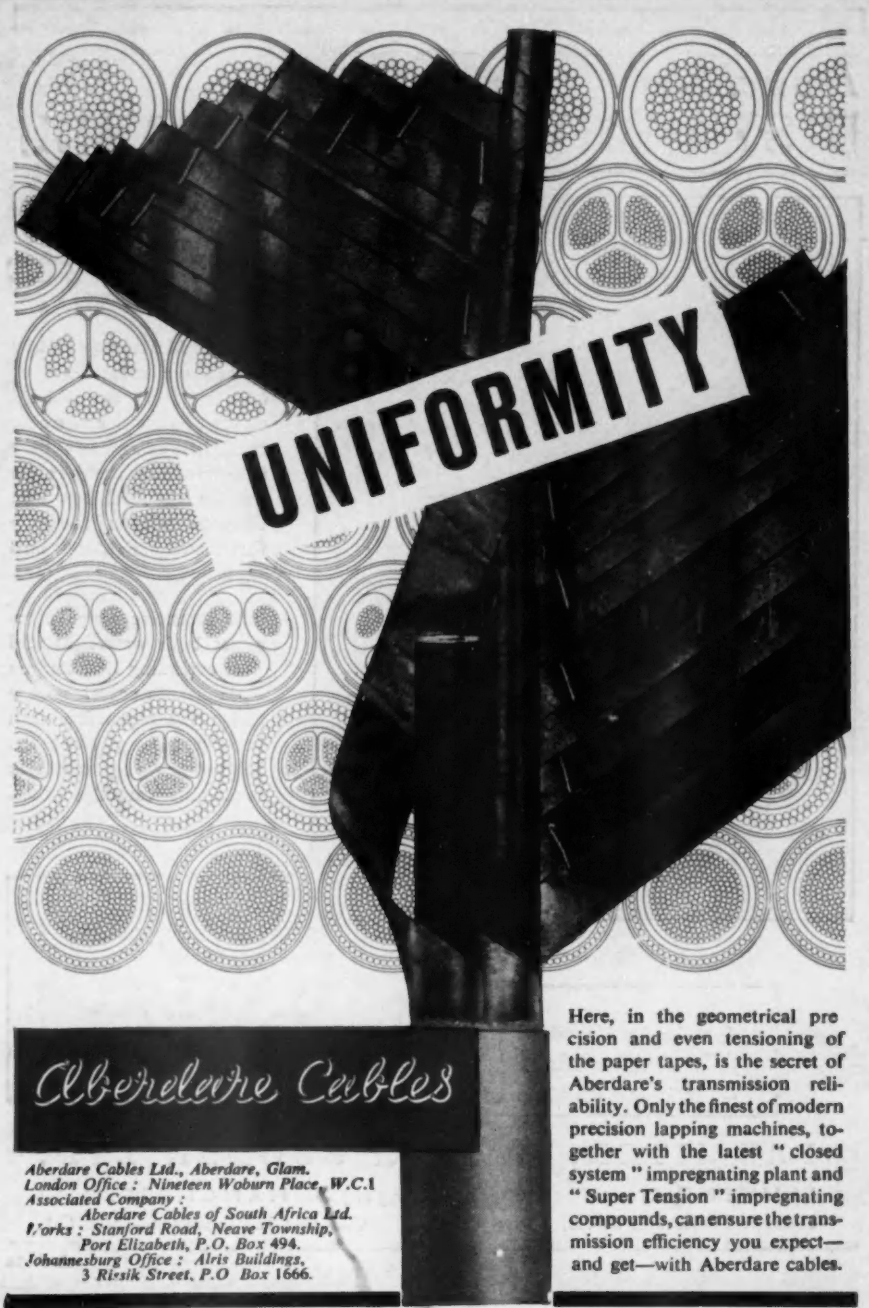
List Section No. 28A fully describes these distribution boards.

AEROFLEX
Fluvent
HOPE'S PATENTS

PARMITER, HOPE & SUGDEN LTD.

FLUVENT *Electrical Works, Longsight,* **MANCHESTER 12**
London: 34 Victoria Street, S.W.1. Glasgow: 162 Buchanan Street, C.1.

dm PH 26



Here, in the geometrical precision and even tensioning of the paper tapes, is the secret of Aberdare's transmission reliability. Only the finest of modern precision lapping machines, together with the latest "closed system" impregnating plant and "Super Tension" impregnating compounds, can ensure the transmission efficiency you expect—and get—with Aberdare cables.

Aberdare Cables Ltd., Aberdare, Glam.
London Office : Nineteen Woburn Place, W.C.1
Associated Company :
Aberdare Cables of South Africa Ltd.
Works : Stanford Road, Neave Township,
Port Elizabeth, P.O. Box 494.
Johannesburg Office : Alris Buildings,
3 Rissik Street, P.O Box 1666.